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A NEW AID IN REMOVAL OF FOREIGN BODIES OF THE CORNEA

TOPICAL APPLICATION OF SILVER NITRATE

D. F. GILLETTE, M.D.

SYRACUSE, N. Y.

In this paper a new method of removal of foreign bodies from the superficial epithelium of the cornea is described. It is applicable to all foreign particles but is here chiefly concerned with the foreign bodies with an iron content encountered in industry. These quickly produce a rust stain, which becomes so firmly attached to the tissues that its removal often causes considerable damage to the corneal epithelium.

Injuries to the eye are the most disabling and costly of all nonfatal industrial accidents.[1] Most of them are caused by foreign bodies in the cornea.[2] Treatment should be prompt, efficient and economical, for infection delays healing, promotes scarring and may impair function, or even destroy the eye itself.[3]

The foreign bodies are usually hot [4] and cause a burn when they strike the cornea. The burn and the subsequent rust stain become firmly attached to the surrounding tissue.

The chemical composition of the stain has not been established. There are various theories. Leber [5] and Fuchs [6] called it hydrate of ferric oxide, while Gruber [7] described it as a hydroferric oxide. Gruber, moreover, produced similar stains by introducing sterile particles of iron into the cornea of cats and proved the presence of iron in them. He claimed that metallic iron and the ferrous oxide cause more irritation than the ferric oxide. He showed that even the chemically inert rust ring may, and usually does, slough out after inflammation of the epithelium.

Most ophthalmologists demand that the foreign body, burn and stain be carefully and completely removed as soon after the injury as possible. A minority, however, prefer to leave the stain, and at times even the foreign body and burn, to slough out rather than risk the added trauma of removal. This sloughing out requires a variable length of time and usually results in infection, with painful and disabling complications. The

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Presented as a candidate's thesis for admission to the American Ophthalmological Society in 1943.

1. McCannel, A. D.: Treatment of Common Eye Injuries, Minnesota Med. **24**:939-942 (Nov.) 1941. Rados, A.: The Eye, in Kessler, H. H.: Accidental Injuries, Philadelphia, Lea & Febiger, 1941, chap. 15.

2. Alvis, E. O.: The Eye in Industry, J. Indiana M. A. **34**:239-244 (May) 1941. Cabaniss, W. H.: The Importance of Prompt Treatment of Eye Injuries, J. M. A. Georgia **19**:513-515 (Dec.) 1930. Cridland, B.: Minor Injuries of the Eye in Industry, Brit. M. J. **2**: 615-617 (Oct. 5) 1929. Cross, G. H.: Ocular Injuries: Their Treatment, Arch. Ophth. **7**:357-360 (March) 1932. Garrow, A.: A Statistical Inquiry into One Thousand Cases of Eye Injuries, Brit. J. Ophth. **7**:65-80 (Feb.) 1923. Gulliver, F. D.: The Most Common Eye Injury: A Practical Consideration, read at the Fifty-First Annual Session of the New York and New England Association of Railway Surgeons, Dec. 5, 1941. Jones, C. D.: First Aid to the Injured Eye, Virginia M. Monthly **56**:96-98 (May) 1929. Miller, J. S., Jr.: Industrial Ophthalmology, Hahneman. Monthly **74**:97-107 (Feb.) 1939. Minton, J.: Industrial Eye Injuries, Indust. Welfare **20**:265-271 (July) 1938. Nutting, R. J.: Industrial Corneal Injuries, California & West. Med. **30**:344-345 (May) 1929. Vidal, J.: Infortunistica ocular, Hospital, Rio de Janeiro **20**:379-404 (Sept.) 1941. Wernner, W. T.: Foreign Bodies in Cornea: Care and Complications, Minnesota Med. **22**:28-31 ,Jan.) 1939.

3. Begle, H. L.: Problems in the Care of Industrial Injuries of the Eye, J. Michigan M. Soc. **20**:443-446 (Nov.) 1921. Benedict, W. L.: Office Treatment of Eye Injuries, Wisconsin M. J. **38**:187-190 (March) 1939. Black, G. W.: Ophthalmic Emergencies, Practitioner **140**:478-488 (April) 1938. Brown, J. E.: Eye Injuries and the Workmen's Compensation Law, Ohio State M. J. **16**:909-914 (Dec.) 1920. Caldwell, R.: Industrial Eye Injuries, South. M. J. **18**:619-621 (Aug.) 1925. Campbell, D. M.: Some Phases of Industrial (Factory) Eye Surgery, J. Michigan M. Soc. **27**:666-667 (Oct.) 1928. Gifford, S. R.: Ocular Foreign Bodies: Importance of Immediate and Proper Care, Indust. Med. **6**:129-132 (March) 1937. Parsons, J. H.: Treatment of Minor Injuries to the Eye, Lancet **1**:451-452 (March 3) 1923. Patton, J. M.: The Management of Ocular Injuries, Nebraska M. J. **15**:429-432 (Nov.) 1930.

4. Walker, S., Jr., and Auten, H. L.: Industrial Injuries to the Eye: Essentials of First Aid and Late Management, J. A. M. A. **116**:1356-1357 (March 29) 1941.

5. Leber, T.: Die Entstehung der Entzündung und die Wirkung der entzündungerregenden Schädlichkeit. Nach vorzugsweise am Auge angestellten Untersuchungen, Leipzig, W. Engelmann, 1891, pp. 220-225.

6. Fuchs, E.: Injuries of the Cornea, in Textbook of Ophthalmology, ed. 4, translated by A. Duane, Philadelphia, J. B. Lippincott Company, 1913, p. 286.

7. Gruber, R.: Ueber Rostablegerung in der Hornhaut, Arch. f. Ophth. **40**:154-171, 1894.

method described in this paper anticipates the localized softening of the epithelium and aids in the immediate, safe and complete removal of the foreign body, burn and stain.

METHOD

Silver nitrate has long been used in ocular therapeutics as a prophylactic, antiseptic and caustic agent. The method I describe here utilizes the chemicophysical reaction produced by the topical application of a 1 to 3 per cent solution of silver nitrate to the foreign body and the surrounding epithelium. The solution is applied by a small thread of cotton spun on the sharpened end of a round wooden toothpick. The cotton is cut off clean with sterile scissors so as to remove any stray fibers that might spread the solution over too large an area of the cornea.

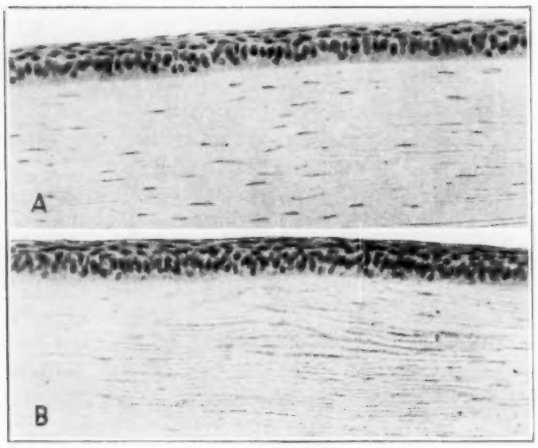

Fig. 1.—*A*, section of uninjured cornea of the rabbit eye treated with a 1 per cent solution of silver nitrate; *B*, section of the uninjured cornea of the rabbit eye treated with a 3 per cent solution of silver nitrate.

The reaction is a faint, gray swelling of the superficial epithelium, which elevates the foreign body slightly above the level of the surrounding epithelium. This swelling appears to be caused by local softening and edema of the tissue. It has been observed that a 1 per cent solution of silver nitrate usually produces a sufficient reaction. The 3 per cent solution, which acts faster and produces a greater reaction, was used in several cases in early experiments. The reaction produced by the silver nitrate was inspected with the slit lamp and tested by experiments on animals.[8]

ANIMAL EXPERIMENTS

Normal and abraded corneas of rabbit eyes were treated topically with 1 and 3 per cent solutions of silver nitrate. The animals were killed and the corneas removed fifteen minutes after topical application of the solution. The corneas were then fixed, sectioned and stained.

Photomicrographs of these sections of the cornea of the rabbit eye show the effect of the solutions of silver nitrate on the superficial epithelium. *A* of figure 1, a section of an uninjured cornea which was treated with a 1 per cent solution of silver nitrate, shows no definite change. In *B* of the same figure, a section of an uninjured cornea treated with a 3 per cent solution of silver nitrate, a slight amount of pigmentation is apparent in the outer layers of the epithelium.

In *A* of figure 2, a section of the abraded cornea treated with a 1 per cent solution of silver nitrate, the epithelium is pyknotic and stained with silver nitrate. In *B*, a section of the abraded cornea treated with a 3 per cent solution of silver nitrate pronounced pyknosis and deeper staining of the epithelium are apparent. Unfortunately, the injury of the epithelium in this eye was more severe than that in the eye shown in *A*.

Figure 3 *A* shows a section of an abraded cornea of the rabbit eye which was removed and fixed fifteen minutes after the topical application of a 1 per cent solution of silver nitrate. A fine cotton applicator saturated with the solution had been kept in contact with the epithelium for one minute. The superficial layers of epithelium are necrotic and have sloughed off. Impregnation with the silver salt is seen. The basal cells, which appear in place, are partly swollen and partly shrunken. They are separated by interstices, which are interpreted as due to edema. A few nuclei are pyknotic, and the cytoplasm has taken a darker stain. In *B* of figure 3, a section

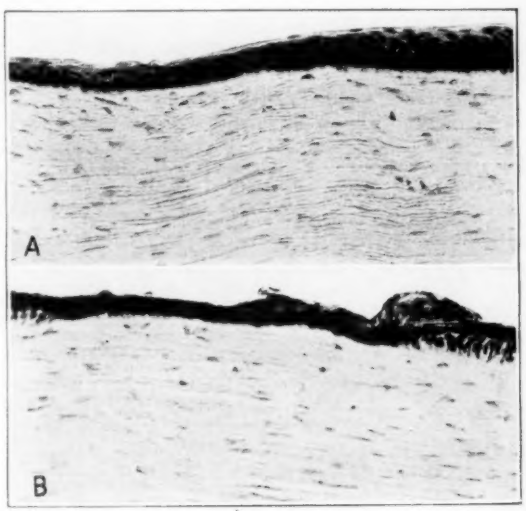

Fig. 2.—*A*, section of the abraded cornea of the rabbit eye treated with a 1 per cent solution of silver nitrate; *B*, abraded cornea of the rabbit eye treated with a 3 per cent solution of silver nitrate.

8. Ferguson, J. H., in Reports from the Department of Pathology, Syracuse University College of Medicine, February, March and April 1943. Von Sallmann, L., in Report from Columbia University College of Physicians and Surgeons, Department of Ophthalmology, May 1943.

of an abraded cornea which was removed and fixed one hour after similar treatment with a 3 per cent solution of silver nitrate, the cornea is almost denuded of epithelium, and a few shrunken cell bodies with pyknotic nuclei constitute the remnants of the basal layer. The section shows no definite changes in the stroma, and the endothelium is normal.

These observations indicate that the solution of silver nitrate had not penetrated through the cornea and substantiate reports on the pharmacologic effect of silver nitrate in burns due to the drug (such as those of the conjunctiva) in which the coagulation necrosis affects only the more superficial layers of the epithelium. Regeneration takes place in a short time. The experiments support my belief that it is best to apply the 1 per cent solution of silver nitrate for only two or three seconds.

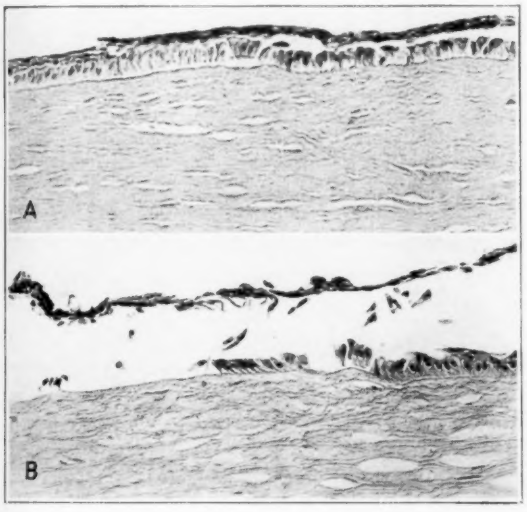

Fig. 3.—*A*, section of abraded cornea of the rabbit eye which was removed and fixed fifteen minutes after topical application for one minute of a 1 per cent solution of silver nitrate; *B*, section of the abraded cornea of the rabbit eye which was removed and fixed one hour after topical application of a 3 per cent solution of silver nitrate.

The literature on removal of foreign bodies from the cornea reveals two chemical approaches to the problem. Páez Allende[9] used a 5 per cent solution of a cocaine salt to "destroy the epithelial cells that held the foreign body." Rycroft,[10] in a case of multiple foreign bodies, instilled a 4 per cent solution of a cocaine salt into the eye until he was able to peel off the softened superficial epithelium.

In my experimental investigation of the method I describe I placed several particles of iron in the superficial epithelium of the cornea of rabbits. The stains formed within an hour. The foreign bodies and their immediate borders were treated with a 3 per cent solution of silver nitrate. The epithelium so treated became faintly gray and edematous. The reaction elevated the foreign body on a shallow dome of swollen tissue. The foreign body and the stain were then removed with little additional trauma to the epithelium. This topical use of the silver solution did not permanently damage the epithelium, did not delay healing and did not produce a silver oxide stain that remained visible with the slit lamp.

This method, with the employment of 1 per cent solution of silver nitrate, was then tried with 3 patients with foreign bodies of the cornea. The results were so good that use of the method was continued.

CLINICAL APPLICATION

The patient was tilted back in a dressing chair which supported his head in a firm position, and one which was comfortable for both him and the operator. The injured eye was carefully anesthetized by instillation of 1 drop of a 0.5 per cent solution of tetracaine hydrochloride at one minute intervals. Two or three instillations were usually enough to produce complete surface anesthesia. The eye was then carefully inspected with a self-illuminated binocular loupe. The use of this instrument left both the operator's hands free so that he was able to control the head and lids with one hand and use the other for the operation. The patient was instructed to keep both eyes open and fixed on a point to facilitate the inspection and operation.

The slit lamp was used to locate the minute foreign particles that could not be satisfactorily seen with the loupe. The very small dark particle located in the pupillary area of the cornea in 1 case was easily delineated by retroillumination. The conjunctival sac was irrigated with 5 or 6 drops of a mild solution of mercury oxycyanide.[11] When necessary, a drop of a sterile 2 per cent solution of fluorescein sodium was used to map an abrasion of the cornea or to outline the foreign body. The nature, size and depth of the foreign body, as well as any stain or sign of infection, were carefully noted.

The 1 per cent solution of silver nitrate was then applied to the foreign body. The reaction which developed in one minute was sufficient.

9. Páez Allende, F.: Cuerpo extraño de la córnea, Día méd. **11**:626 (July 17) 1939.

10. Rycroft, B. W.: The Non-Magnetisable Metallic Foreign Bodies of the Cornea, with the Report of a Case, Brit. J. Ophth. **14**:501-506 (Oct.) 1930.

11. The solution had the following composition: mercury oxycyanide, 1.25 mg.; mercury cyanide, 2.50 mg.; boric acid, 1 per cent, 30 cc.

Removal of the foreign body was then attempted with a sterile, pointed wooden applicator, tightly wound with cotton. For the past three months I have used the sharpened end of a round toothpick. These toothpicks are kept in the steam sterilizer, so that the point is as soft as, and finer than, that of the cotton-wound applicator.

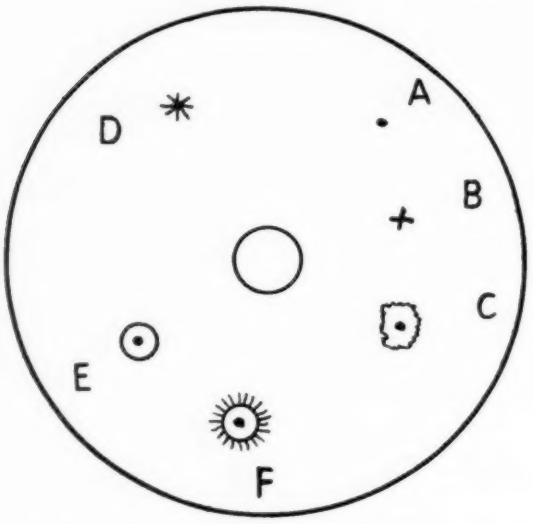

Fig. 4.—Graphic representation of the site and nature of the foreign body and local complications.

A indicates foreign body; *B*, foreign body with stain; *C*, foreign body with abrasion; *D*, foreign body with infiltration; *E*, foreign body with ulcer, and *F*, foreign body with ulcer and zone of infiltration.

This method aided the complete removal of the foreign body, burn and stain when the patient was treated soon after injury. When, however, the stain did not readily come away, the point of a cystotome was used gently to lift it out. When the patient was seen late, the foreign body and burn were easily removed, but the stain, having further penetrated the tissues, was not always dislodged with the applicator.

In the patients who were treated late the point of the cystotome was used carefully to free and lift out the stain. A cystotome, with the cutting edge removed, is an ideal instrument, for it has a fine point and requires but a slight roll of the handle to give the necessary lift to the point. It also allows a smoothness of movement not possible with the foreign body spuds or the knife needle. The cystotome produced little trauma as compared with that caused by the foreign body spud, the curet or the dental burr, each of which produces unnecessary destruction of tissue. This fact is readily demonstrated with the slit lamp. In 2 cases the stained disk was observed to be attached to the cornea by a tough pedicle. A fine, smooth forceps was used to tear these attachments away from the cornea.

Injury to Bowman's membrane was avoided, for such a lesion exposes the less resistant stroma of the cornea to possible infection and always heals with scar formation. The silver nitrate procedure was not used when Bowman's membrane had been injured, for it allowed the solution to spread into the deep interspaces and produce unwanted stain.

White's ointment (crude coal tar, zinc oxide and petrolatum), or sulfathiazole ointment, 5 per cent, was instilled immediately after the removal of the foreign body and stain. When possible the eye was protected with a sterile eye patch, held snugly in place with Scotch tape. In 2 cases contact dermatitis developed from the use of this adhesive.

The patient was instructed to instil some of the ointment if the eye became uncomfortable. He was asked to return on the following day with the pad in place. When iritis was present, the pupil was dilated, the mydriatic used depending on the degree of the iritis, the probable length of disability and the possibility of glaucoma.

In the early part of this investigation an ulcer was cauterized with tincture of iodine. This treatment always caused such discomfort that the patient was incapacitated for work for the next six to twelve hours. During the six months, prior to the time of writing an ulcer has been cleansed of its exudate with a small cotton-wound applicator saturated with tincture of metaphen (1:200). The area was then filled with sulfathiazole powder, which was left in place one minute. The undissolved portion was washed away with the tears. This was accomplished by having the patient wink several times. Sulfathiazole ointment, 5 per cent, was prescribed for use after the powder. The patient was instructed to use the ointment and hot

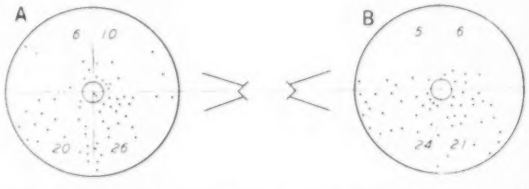

Fig. 5.—Graphic representation of the location of 118 foreign bodies occurring in 100 unselected cases of injury to the eye treated by the method described.

A shows 62 foreign bodies in the right eye (55 cases), and *B*, 56 foreign bodies in the left eye (45 cases).

compresses to relieve any discomfort. Several drops of the weak solution of mercury oxycyanide were instilled to flush the conjunctival sac

when the eye showed any evidence of secretion. Such a potentially infected eye was also treated with a topical application of the sulfathiazole powder. This powder gave good results and was much less irritating than the tincture of iodine. The eyes treated by the silver nitrate method soon after injury healed quickly and without formation of scar. This was so evident that intelligent patients were allowed to remove the dressing if the eye had been comfortable for two hours after treatment by this method.

The patient with signs of infection was ordered to go home and was instructed to apply hot compresses and to instil drops of the weak solution of mercury oxycyanide at regular intervals. The frequency of treatment depended on the pain and the degree of infection. The patient was also instructed to instil White's or the sulfathiazole ointment into the eye after each treatment with the solution and to replace the patch unless, as sometimes happens, it increased the pain. In this event he was told to wear the black glasses which were furnished him.

The ophthalmic examination and record were made as complete as possible at the patient's first visit and were finished as soon as the condition of the eye permitted. The site and nature of the injury were graphically recorded, as indicated in figure 4. In figure 5 are represented the sites of the 118 foreign bodies occurring in 100 unselected cases in which this method of treatment was used. The diagram shows that the great majority of the foreign bodies were located in the middle portion of the lower half of the cornea. This area represents the interpalpebral space when the patient is looking slightly down, as at his work.

COMMENT

Table 1 shows that by far the greatest number of injuries from foreign bodies in the cornea

TABLE 1.—*Occupation at Time of Injury*

	No. of Cases
Operation of abrasive wheel	44
Machining of tools, such as lathe and shaper	19
Hammering, chipping, etc.	8
Cleaning casting with wire brush	8
Cleaning up with air hose	9
Welding	1
Miscellaneous work	11

are incurred before the abrasive wheel, but many are obtained at machining tools, such as the lathe and shaper. In table 2 is recorded the time which elapsed between the injury and the treatment. The cases are divided into convenient groups on this basis. In table 3 are shown the number of cases in each time group in which the cotton-wound or soft-pointed applicator was successfully used and the number in which employment of the cystotome was required. Table 4 shows the average period of disability for each time group and demonstrates the economy of early, careful treatment. The values were determined on the basis of a twenty-four hour day because number of work hours was variable as a result of necessary periods of overtime work.

TABLE 2.—*Interval Between Injury and Treatment*

Time Group, Hours	No. of Cases
0- 6	36
6-12	19
12-24	26
24-48	8
48-72	8
72 plus	3

TABLE 3.—*Analysis of Methods of Treatment Required on Basis of Time After Injury*

Time Group (Hours After Injury)	Cotton Applicator		Cystotome	
	Number	Percentage	Number	Percentage
0- 6	34	94.4	2	5.6
6-12	8	42.0	11	58.0
12-24	7	27.0	19	73.0
24-48	0	0.0	8	100.0
48-72	1	12.0	7	88.0
72 plus	0	0.0	3	100.0

TABLE 4.—*Average Number of Days of Disability per Group*

Hour Groups	Days of Disability
0- 6	0.027
6-12	0.421
12-24	0.73
24-48	0.80
48-72	1.62
72 plus	4.00

CONCLUSIONS

The topical application of silver nitrate before removal of foreign bodies from the cornea is of value for these reasons: (*a*) It facilitates removal of the foreign body, burn and stain from the corneal epithelium; (*b*) it causes a minimum amount of trauma, and (*c*) it is economical, for it conserves time and function. The results indicate that the earlier the patient is treated the more successful is the method.

Dr. Arnold Knapp and Dr. Ludwig von Sallmann, of the Institute of Ophthalmology, New York, and Dr. J. H. Ferguson and Dr. M. S. Dooley, of the faculty of Syracuse University College of Medicine, gave advice in this investigation.

109 South Warren Street.

A WORD OF CAUTION IN USE OF PENTOTHAL SODIUM IN OPHTHALMIC SURGERY

HAROLD F. FALLS, M.D.*
ANN ARBOR, MICH.

Pentothal sodium, a short-acting barbiturate, has been widely employed as an anesthetic for intravenous administration during the past few years. The large number of articles currently appearing in scientific journals concerning its use indicates that the drug is now occupying the crest of its wave of popularity. Pentothal sodium is a powerful and rapidly acting drug, which may be employed for operations requiring only analgesia or procedures of short duration. It should be administered only by persons trained and experienced in its pharmacologic action and in specific resuscitative procedures. The drug is potentially dangerous, since it is a depressant of the respiratory center in the medulla. Recent experimental work[1] indicates that pentothal sodium effects an early loss of precise control of breathing and of the acid-base equilibrium. This depressant action of pentothal sodium on respiration should restrict its use to short, relatively atraumatic operative procedures.

Many ophthalmologists have been prone to accept pentothal sodium without reservation. Its use in ophthalmic operations is rapidly becoming general. The freedom of the ophthalmic operative field granted by use of the drug is to be commended as well as the ease and rapidity of induction. Without a complete analysis of the results of its use, pentothal sodium would seem to be an ideal anesthetic for ophthalmic surgical procedures, and in the great majority of cases this may be true. It is the purpose of this paper, however, to report untoward reactions and complications encountered during and after the administration of pentothal sodium in 147 cases in which ophthalmic operations were carried out at the ophthalmic clinic from July 1940 to March 1943. A short discussion of 1 case of death and of several cases of apnea encountered during and after operation, as well as of procedures employed to combat this complication, is included.

METHOD OF ADMINISTRATION

The slow, intermittent method of induction and the intermittent administration of supplemental doses as required constitute the accepted method.[2] The drug must not be given too rapidly. A 2.5 per cent solution of pentothal sodium in water has been found to be the most satisfactory concentration. The continuous administration of oxygen, with or without supplemental nitrous oxide, is now recommended by nearly all anesthetists and surgeons. Premedication is the practice of the great majority of anesthetists. The most satisfactory premedicaments are morphine sulfate and atropine sulfate, given hypodermically. The dose must be individualized according to such factors as weight, constitutional status and basal metabolic rate. It is thought best to give atropine sulfate fifteen to thirty minutes before induction of anesthesia is initiated. Morphine sulfate may be given one to one and one-half hours before operation. The latter drug is thought to increase the analgesia and reduce the amount of pentothal sodium required, as well as to prevent excitement and muscular activity during and after induction. Atropine or scopolamine effects paralysis of the parasympatheticomimetic action of intravenously administered barbiturates, so that excess mucus and pharyngeal and laryngeal spasm are reduced. The ophthalmologist will find it necessary to instil 1 drop of a 4 per cent solution of cocaine hydrochloride into each eye at five minute intervals before beginning the administration of pentothal sodium to avoid reflex vagal sneezing and coughing on stimulation of the fifth nerve.

CONTRAINDICATIONS

Intravenous anesthesia is not practical or safe for children, since the margin of safety is small and large amounts are necessary to effect analgesia. Obese subjects are difficult to anesthetize because of the small, deep, hidden veins. The site and method of destruction of the drug are not known, and until investigation clarifies this process it is felt that nephritic and hepatic disease are contraindications to the use of the drug. Increased intracranial pressure, because of the associated depression of respiration, prohibits the use of a respiratory depressant. Pentothal sodium is not suitable for long surgical procedures which require adequate muscular relaxation.

REVIEW OF CASES OF OPHTHALMIC SURGICAL PROCEDURES

A total of 147 consecutive and unselected cases in which ophthalmic operations were carried out provided the material for this review. Division of this number on the basis of sex revealed that in 80, or 54.41 per cent, the patients

* Walter R. Parker Scholar, University of Michigan Medical School.

1. Beecher, H. K., and Moyer, C. A.: J. Clin. Investigation **20**:549-566 (Sept.) 1941.

2. Lundy, J. S.: Clinical Anesthesia, Philadelphia, W. B. Saunders Company, 1942.

were males and in 67, or 45.59 per cent, they were females. The average age was 35.52 years. The youngest patient was 7 years and the oldest 83 years of age.

TABLE 1.—*Various Procedures Employed in One Hundred and Forty-Seven Ophthalmic Operations*

Surgical Procedure	No. of Cases	Percentage
Operations on extraocular muscles	52	35.36
Iridectomy	9	6.12
Enucleation	24	16.32
Cataract extraction	7	4.76
Linear cataract extraction	1	0.68
Conjunctivoplasty	7	4.76
Removal of biopsy specimen of orbital tumor	3	2.04
Evisceration	15	10.20
Frost suture	1	0.68
Dacryoconjunctivorhinostomy	1	0.68
Paracentesis	2	1.36
Implantation of vitallium ball	1	0.68
Dacryocystorhinostomy	2	1.36
Plastic repair	2	1.36
Extirpation of lacrimal sac	5	3.40
Exenteration	5	3.40
Trephination	4	2.72
Cyclodiathermy	1	0.68
O'Connor transplantation	1	0.68
Needling	1	0.68
Dilatation of lacrimal sac	1	0.68
Dressing of orbit	1	0.68
Incision and drainage of lacrimal sac	1	0.68

The average amount of pentothal sodium administered in each case was 37.48 cc. of the 2.5 per cent solution. The greatest single amount administered was 118 cc. The average duration of anesthesia was thirty-four and twenty-one-hundredths minutes. Thus, approximately 1.09 cc. of a 2.5 per cent solution of pentothal sodium was administered per minute per case.

TABLE 2.—*Operative Course in One Hundred and Forty-Seven Ophthalmic Operations in Which Anesthesia Was Induced with Pentothal Sodium*

Operative Course	No. of Cases	Percentage
Satisfactory	97	65.96
Formation of airway necessitated	8	5.44
Coughing	8	5.44
Laryngeal spasm	1	0.68
Cyanosis	5	3.40
Light anesthesia used	5	3.40
Sneezing	6	4.08
Large amount of pentothal sodium required for induction	15	10.20
Apnea	8	5.44
Artificial respiration required	6	4.08
Straining	6	4.08
Shallow and poor respiration	5	3.40
Extrasystoles	3	2.04
Death	1	0.68
Very moist rales	3	2.04

The ophthalmic operations included twenty-three procedures, of which operations on ocular muscles, enucleations, eviscerations, conjunctivoplastic procedures and extractions of cataracts constituted the greater percentage (table 1).

In 97, or 65.96 per cent, of the cases there was no complicating incident during induction of anesthesia or operation. In 15, or 10.21 per cent, of the cases large amounts of pentothal sodium were required for induction of anesthesia. It is suggested that other anesthetic agents should be employed when induction is difficult and large quantities are required. Coughing or sneezing was present in 9.52 per cent of cases. Adequate cocainization of the cul-de-sac has greatly reduced this complication during the past two years (table 2).

Apnea occurred in 8 cases, in 1 of which it terminated in death.

REPORT OF EIGHT CASES IN WHICH APNEA OCCURRED

CASE 1.—A Negro aged 76 was subjected to enucleation for a painful secondary glaucoma. Apnea immediately followed removal of the eye or appeared on cessation of the painful stimulation of respiration incident to operation. The heart continued to beat for a short period after respiration ceased. Artificial respiration, administration of oxygen under pressure, intracardiac injection of epinephrine, injection of nikethamide and painful peripheral stimulation failed to restore respiration, and death occurred in four minutes. A limited postmortem examination failed to show any damage that might have been produced by the pentothal sodium itself. Severe, generalized arteriosclerosis and arteriosclerotic heart disease were present. It is believed that the painful stimuli from the eye were sufficient to keep the respiratory rate at a level which did not awaken suspicion during the operation even though an overdose of pentothal sodium had been given. The true situation became evident only when the abnormal respiratory drive provided by the "painful" stimuli stopped. The administration of 100 per cent oxygen under pressure after the apnea became apparent may have further depressed respiration as a result of the anoxia-allaying action of a relatively high arterial oxygen tension on the carotid body.

CASE 2.—A white man aged 64 was subjected to evisceration of the eye for chronic iridocyclitis. Momentary apnea was displayed during the early stage of induction of anesthesia, after 12 cc. of a 2.5 per cent solution of pentothal sodium had been injected. Spontaneous respirations were resumed when further injection was withheld. Too rapid induction of anesthesia was probably responsible for the apnea.

CASE 3.—A well developed, muscular youth aged 18 was subjected to surgical correction of strabismus. Apnea of short duration was manifested on injection of 9 cc. of a 2.5 per cent solution of pentothal sodium. Respiration was resumed spontaneously, and the operative course was otherwise uneventful. It was believed that in this case, too, induction of anesthesia was too rapid.

CASE 4.—A white woman aged 52 was subjected to evisceration of the right eye for panophthalmitis. No premedication had been given this patient, who was extremely apprehensive. Severe apnea immediately followed evisceration of the ocular contents. Artificial respiration, administration of 100 per cent oxygen and intravenous injection of nikethamide were employed to restore spontaneous respiration. It is now recognized that administration of 100 per cent oxygen was dangerous in this case because of its effect on the control of breathing by the carotid sinus reflex.

CASE 5.—A man aged 62 was subjected to enucleation for endophthalmitis. The procedure lasted thirty-five minutes, and a total of 45 cc. of a 2.5 per cent solution of pentothal sodium was administered. The operative course was uneventful, but shortly after he returned to the ward respiration ceased. Artificial respiration and intravenous injections of nikethamide and picrotoxin were employed to restore spontaneous respiration. The patient did not react for two and one-half hours and was very drowsy for at least sixteen hours longer. This case emphasizes the point that careful postoperative observation of the patient is a necessary part of pentothal sodium anesthesia.

CASE 6.—A white man aged 52 with arteriosclerotic heart disease was subjected to exploration of the right orbit in order to obtain a specimen of an orbital tumor for biopsy. Respirations became shallow soon after initiation of the operation, and two momentary periods of apnea were encountered. The operation lasted one hundred minutes, 80 cc. of a 2.5 per cent solution of pentothal sodium being injected during that period. It is believed that the depression of respiration in this case resulted from the large amount of the drug employed during the long surgical procedure. The patient did not react for four hours after operation.

CASE 7.—A white woman aged 35 was subjected to enucleation of the left eye for secondary glaucoma following intraocular hemorrhage. The patient had severe essential hypertension, the blood pressure being 240 systolic and 150 diastolic. Intravenous administration of pentothal sodium was chosen because of the fall in blood pressure reported in cases of essential hypertension; it was believed, therefore, that the patient would do best with this anesthetic. A minor degree of apnea was experienced after 10 cc. was injected. This was quickly overcome by administration of a combination of nitrous oxide and oxygen. A second, more serious, period of apnea followed removal of the eye. Spontaneous respiration was restored by the use of artificial respiration, nikethamide and a mixture of nitrous oxide and oxygen. The patient did not respond for two and one-half hours. Severe nausea and vomiting persisted for several hours after response was obtained. The patient died sixteen days after operation. The postmortem examination revealed severe hypertensive heart disease and pyelonephritis. No connection between the previous administration of pentothal sodium and the cause of death was determined.

CASE 8.—A white boy aged 7 years was subjected to exenteration of a large spindle cell sarcoma of the left orbit. The patient had had no premedication. A brief induction of anesthesia was followed by a satisfactory course until the operation was nearly completed. Momentary apnea appeared, which was relieved by artificial respiration. The patient did not fully respond until the next day and showed evidences of shock. The pulse was rapid; the respirations were shallow, and the color was poor. A blood transfusion, together with other supportive treatment, was administered. The operation lasted for ninety minutes, during which 50 cc. of the 2.5 per cent solution of pentothal sodium was injected.

It must be admitted that in the majority of these cases apnea was the sequela of errors in the technic of administration, and perhaps in the choice, of the anesthetic. It is desired that these cases shall serve as examples of such error and that similar mistakes will be avoided in the future.

In a rather high proportion, 10.21 per cent, of the cases a large amount of pentothal sodium was required for induction of anesthesia. It is urged that the anesthetist change to inhalation anesthesia when it is apparent that the patient is resistant to the effects of the drug.

EFFECTS OF PENTOTHAL SODIUM ANESTHESIA

Postoperative Complications (table 3).—The relative freedom from postanesthetic complications after employment of pentothal sodium has been stressed by many authors,[3] but, as an ophthalmologist, I view with alarm the high percentage of cases of nausea (24.48) and emesis (17.68) in this series. Postoperative nausea and emesis are difficult to evaluate when one is analyzing the effects of pentothal sodium, since psychic influences, nervous tension and sensitization to drugs used in premedication must be considered. Even granted the necessity of occurrence of the aforementioned complications, it is felt that the percentages are higher than those observed after similar procedures performed with local anesthesia. Nausea and emesis are serious postoperative complications of ophthalmic operations, particularly intraocular

TABLE 3.—*Incidence of Postoperative Complications After Use of Pentothal Sodium Anesthesia in One Hundred and Forty-Seven Ophthalmic Operations*

Postoperative Course	No. of Cases	Percentage
Satisfactory	54	36.72
Restlessness	23	15.64
Emesis	26	17.68
Period before response was obtained		
1 hour	8	5.44
2 hours	6	4.08
3 to 5 hours	8	5.44
Coughing	5	3.40
Nausea	36	24.48
Severe headache	2	1.36
Apnea	2	1.36
Artificial respiration required	3	2.04
Respiration shallow	4	2.72
Patient irrational and difficult to handle	2	2.04
Profuse sweating	1	0.68

TABLE 4.—*Effect on Respiration of Pentothal Sodium Anesthesia in One Hundred and Forty-Seven Ophthalmic Operations.*

Respiratory Rate	No. of Cases	Percentage
Rise: 3-6 (moderate)	23	15.64
Over 6 (pronounced)	23	15.64
Fall: 3-6 (moderate)	10	6.80
Over 6 (pronounced)	6	4.08
No essential change	85	57.80

3. Long, C. H., and Ochsner, A.: Surgery **11**:474 (March) 1942.

procedures, because of the damaging sequelae of the resultant suddenly increased intraocular pressure.

The prolonged postoperative period of reaction, present in nearly 14.96 per cent of cases, is the result of the rather large doses of pentothal sodium employed. Careful nursing care is required during this state of unconsciousness. Passage of air must be maintained, and frequently the chin must be supported to avoid respiratory embarrassment. Prompt relief of apnea by appropriate resuscitative measures is necessary to avoid death.

Pulse Rate (table 5).—In general, the pulse rate increased slightly during the administration of pentothal sodium. However, individual variations in this respect were encountered.

Blood Pressure.—The blood pressure increased to a minimal degree early in the course of the anesthesia but later tended to fall slightly below the original level.

TABLE 5.—*Effect on Pulse Rate of Pentothal Sodium Anesthesia in One Hundred and Forty-Seven Ophthalmic Operations.*

Pulse Rate	No. of Cases	Percentage
Rise: 5-19 (moderate)	45	30.60
Over 20 (severe)	20	13.60
Fall: 5-19 (moderate)	26	17.68
Over 20 (severe)	11	7.48
No essential change	45	30.60

SUGGESTED REGIMEN FOR RESUSCITATION OF PATIENTS IN APNEA

When respiratory failure occurs during pentothal sodium anesthesia, artificial respiration by thoracic pressure is indicated.[4] A gas mixture containing not more than 40 per cent oxygen and not more than 4 to 5 per cent carbon dioxide should be administered, but positive intratracheal (intrapulmonary) pressures are not to be employed. When cardiac failure appears imminent or the blood pressure is low, 2 to 4 minims (0.13 to 0.26 cc.) of epinephrine hydrochloride (1:1,000) should be given intravenously.

These principles were evolved after careful animal experimentation had revealed much that could be applied to human anesthetization. It was found that pentothal sodium effects a profound depression of the stimulating action of carbon dioxide on the respiratory center. This effect has been observed either with or without the use of morphine as a premedicament. Henderson evolved the term anarchapnea for the level of pentothal sodium anesthesia in which the corneal and sciatic reflexes are active and respiration can be driven effectively by reflex stimulation (proprioceptive and chemosensitive). Obviously, the intermittent administration of high oxygen concentrations will reduce the effectiveness of the latter reflex control. In fact, breathing may fail if the administration of a high concentration of oxygen should suddenly be initiated during the time that respiration is under the control of the chemosensitive (carotid sinus) or proprioceptive (vagal) reflexes. Administration of oxygen must be continuous to be safe and of value and must be started before the induction of pentothal sodium anesthesia is initiated.

Pressure on the thoracic wall expels gas from the lungs and provokes proprioceptive impulses and, if strong enough, will stimulate the respiratory center to effect return of spontaneous respiration.

Epinephrine may be necessary to provide an adequate volume flow of blood, the purpose being to provide the brain with oxygen and to remove carbon dioxide.

4. Moyer, C. A.: J. Thoracic Surg. **2**:131-150 (Dec.) 1941.

SUMMARY

Pentothal sodium is a barbiturate and, as such, is endowed with considerable variability of action. Among the chief effects of intravenous administration of the drug is depression of the respiratory center in the medulla.

The lack of adequate signs of impending respiratory failure makes the margin of safety too narrow to permit unqualified use of pentothal sodium.

The 1 case of death and the 7 instances of severe apnea reported here are attributable to errors of technic, but serve to emphasize how dangerous this complication may be.

From the viewpoint of the ophthalmic surgeon many of the postoperative sequelae of administration of pentothal sodium are extremely serious. Restlessness, nausea and vomiting are certainly dangerous when they follow an intraocular operation.

The rather frequent long periods of reaction which follow use of large amounts of pentothal sodium require the careful supervision of both the physician and the nurse so that prompt resuscitative measures can be taken when indicated.

University of Michigan Medical School.

CONGENITAL OPACITIES OF THE CORNEA

CAPTAIN FREDERICK H. THEODORE
MEDICAL CORPS, ARMY OF THE UNITED STATES

The question of congenital corneal opacities was one of the first to attract the attention of the older ophthalmologists. Controversial theories have been postulated as to the origin of such opacities, but none has been universally accepted. With the exception of perhaps one article, apparently no studies of this condition have appeared in the American literature.

The unusual opportunity offered me of examining 6 patients with this anomaly, 2 of them sisters, in whom the opacities were associated with anterior synechiae and other developmental defects, prompted this report, in the hope that it would throw additional light on a somewhat obscure subject.

REPORT OF CASES

Case 1.—Frances T., aged 6 years, was first seen by me on Feb. 7, 1942 at the Manhattan Eye, Ear and Throat Hospital, through permission of Dr. S. Falk. The ocular condition had been present since birth. Vision in the right eye was limited to light perception only and was unimproved with glasses; vision in the left eye was 20/20.

The right eye presented moderate ptosis, due to microphthalmos. Microcornea was also present, the cornea measuring 9 mm. in the vertical and 10 mm. in the horizontal diameter. The outstanding feature of the eye was the presence of a large, sector-shaped corneal opacity extending from the nasal limbus to a point 3 mm. from the temporal limbus and occupying the central 5 mm. of the cornea, completely obliterating the pupillary area (fig. 1). The opacity involved the posterior half of the cornea, fading in intensity anteriorly. The endothelial surface could not be studied. Attached to the margins of the opacity were a number of anterior synechiae, which consisted of thick, ropelike strands of iris tissue, originating mostly in the angle of the anterior chamber. A few strands came from the lesser circle. The iris itself was pale and had a vacuolated appearance, due to lack of most of its anterior, or mesodermal, tissue. The lens and the fundus could not be seen. Rotary nystagmus was present. The tension was 35 mm. (Schiøtz). The pupil dilated moderately.

Examination of the left eye revealed nothing abnormal except a thin, crescentic peripheral zone of superficial vascularization of the cornea from 8 to 1 o'clock and a persistent remnant of pupillary membrane. The tension was 35 mm. (Schiøtz).

Case 2.—Dorothy T., aged 11 years, the sister of the patient in case 1, was seen in the service of Dr. N. De L. L. Fletcher, at the Manhattan Eye, Ear and Throat Hospital on Feb. 8, 1942. The ocular condition had been present since birth. Vision in her right eye was 20/30 — 1, and was unimproved with a + 0.50 D. sphere; vision in the left eye was limited to perception of hand movements. Exotropia of 45 degrees of arc was present in the left eye.

The left eye, which will be described first, presented a picture similar to and symmetric with that of the right eye of the patient's younger sister (case 1). The cornea was slightly microphthalmic, measuring 10 mm. in diameter. A tonguelike opacity arose at the limbus in the region from 9 to 12 o'clock and extended across the nasal two thirds of the cornea to obliterate the pupil likewise (fig. 2 *A*). This opacity, however, was less intense, involving chiefly the most posterior layers of the cornea, with little involvement of the stroma. The temporal border of the opacity was accentuated. Attached to it superiorly were four thick anterior synechiae, consisting of mesodermal elements of the iris arising from the angle of the anterior chamber, and attached inferiorly were several synechiae from the lesser circle of the iris. A few vessels invaded the corneal stroma at the base of the opacity. The lens, vitreous and fundus, which was seen with some difficulty, appeared normal.

The right eye presented a different type of abnormality. Microcornea was present, the cornea measuring 7.5 mm. in the vertical and 9 mm. in the horizontal diameter. The outstanding abnormality was an opacity which formed an almost complete ring around the peripheral 2 to 3 mm. of the cornea, extending from 4 to 3 o'clock (fig. 2 *B*). The major portion of the opacity, from 8 to 3 o'clock, appeared to consist chiefly of a flat membrane adherent to the posterior surface of the cornea. The membrane was seen to arise from the angle of the anterior chamber and was separate from the cornea inferiorly (from 4 to 8 o'clock), joining it only at its superior border by means of a heavy, irregular, knotty adhesion. Thus a free, troughlike interval, or space, was formed, the base of which was deep in the angle of the chamber (fig. 3). At the junction with the membrane the cornea was opaque in front and central to the line of adhesion. One strand of the membrane arose from the lesser circle.

The pupil was ectopic and dilated fairly well. The media and the fundus were normal.

The color of both irises was poor, owing to a paucity of mesodermal elements, which gave a vacuolated appearance. The tension was 23 mm. (Schiøtz) in each eye.

The mother and father of the patients in cases 1 and 2 presented no ocular abnormalities. The family history on both sides was negative for the defect. There was no consanguinity. The general physical examination of both patients revealed nothing abnormal. There was no syndactyly.

Presented in part at a meeting of the New York Academy of Medicine, Section of Ophthalmology, May 18, 1942.

From the Station Hospital, Miami Beach Training Base, Army Air Forces Technical Training Command, Miami Beach, Fla.

The following 4 cases were noted during processing examinations at Miami Beach, Fla., and are presented with the permission of Major Robert M. Johnson, Medical Corps, chief of the ophthalmic section, Station Hospital.

CASE 3.—R. L., aged 21, a soldier, was seen at the Eye Clinic, Station Hospital, Miami Beach Training Base, on April 16, 1943. His ocular condition had been present since birth. Vision in the right eye was 20/30, and examination of this eye showed nothing abnormal.

Vision in the left eye was limited to perception of hand movements and could not be improved with a correction of + 3.00 D. sph. ⊃ + 2.00 D. cyl., axis 80. The eye showed slight microphthalmos, as well as a small cornea, which measured 10.5 mm. in each diameter. Slight ptosis was present. The tension was 18 mm. (Schiøtz).

The cornea presented a large central, roughly circular opacity, measuring about 5.5 mm. in diameter (fig. 4). The opacity was most intense posteriorly but involved in diminishing degree the entire stroma up to Bowman's membrane. The endothelium was disorganized, and

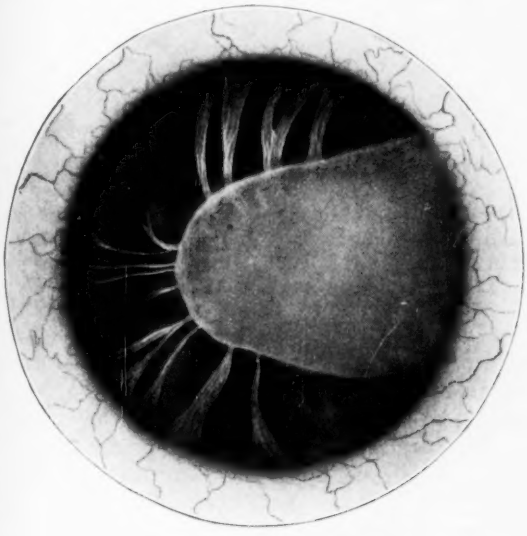

Fig. 1 (case 1).—Right eye.

whorllike defects in it could be seen. In two places in the inferior portion of the opacity thick, broad strands of synechiae arising from the lesser circle of the iris were attached to the posterior corneal surface by means of heavy adhesions. Large defects in the structure of the anterior portion of the iris were present in its inferior half, giving a vacuolated appearance. The pupil dilated fairly well. Examination of the lens revealed a congenital anterior capsular cataract and a small opacity involving the embryonic nucleus and the posterior Y-shaped suture.

The family history was without significance except that an aunt had had congenital cataracts.

CASE 4.—D. A., aged 19, a soldier, was seen at the Eye Clinic, Station Hospital, Miami Beach Training Base, on May 8, 1943. His ocular condition had existed since birth. Vision in the right eye was 20/50 and with a —0.50 D. sphere it was improved to 20/40. Vision in the left eye was 20/40 and was improved to 20/30 by a similar correction. A slight degree of microcornea was present in each eye.

Both eyes presented a similar and almost symmetric picture (fig. 5). In the right eye a corneal opacity, measuring 2 by 3 mm., was present midway between the limbus and the center of the cornea at 3 o'clock. The opacity was most intense posteriorly, where in its center a number of anterior synechiae, arising in broad bands chiefly from the lesser circle of the iris, formed a dense attachment. Around and anterior to this the opacity gradually faded out, but almost reached Bowman's membrane. The iris was thin and lacking in mesodermal elements in its nasal half. Congenital

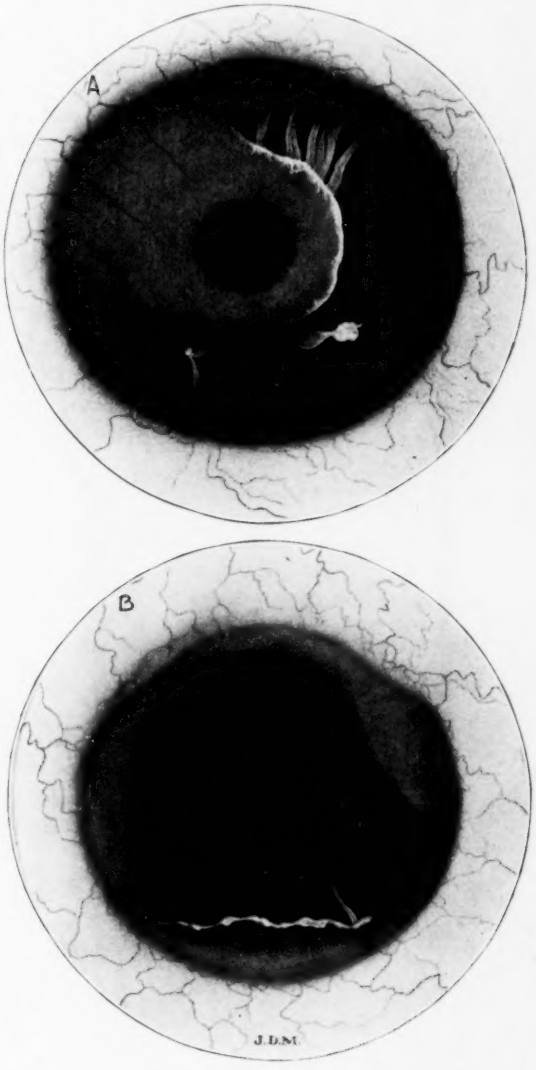

Fig. 2 (case 2).—*A*, left eye; *B*, right eye.

pigment was noted on the anterior capsule of the lens, as well as a fine strand of persistent pupillary membrane.

In the left eye an opacity, similar in every detail, to which similar anterior synechiae were attached, was present at 9 o'clock, midway between the limbus and the center of the cornea. The pupil was piriform, with the long diameter horizontal. Congenital pigment was observed on the capsule of the lens. The tension was normal. The family history was without significance.

CASE 5.—E. G. S., a soldier aged 26, was seen at the Eye Clinic, Station Hospital, Miami Beach Training Base, on May 18, 1943. The ocular condition had

been present since birth. Vision in the right eye was 20/160 and was improved to 20/80 with a correction of —2.00 D. sph. ⌒ + 3.25 D. cyl., axis 90. Vision in the left eye was 20/80 and was improved to 20/40 with a correction of + 2.00 D. cyl., axis 5. The tension was normal in both eyes.

Both eyes presented a condition similar to that of the right eye in case 2. In each eye a flat, ringlike membrane, apparently arising from the angle of the anterior chamber, was attached at its central edge by means of a thick, irregular adhesion to the peripheral 2 to 3 mm. of the cornea from 3 to 9 o'clock (fig. 6). Peripherally, as in case 2, a small free, or troughlike, interval between the membrane and the cornea was seen in places. The corneal stroma anterior to it showed some relucence posteriorly.

The pupil of the right eye was elliptic and was situated so far temporally as to preclude useful vision in this eye. In both eyes the color of the iris was a dirty, muddy gray, due to absence of the anterior layers

Fig. 3 (case 2).—Slit lamp view of the inferior portion of the cornea of the right eye.

of the iris. In the lens of the left eye a fine reduplication cataract and a partial lamellar cataract were noted.

The family history was without significance

Case 6.—D. T., a soldier, was seen at the Eye Clinic, Station Hospital, Miami Beach Training Base, on March 26, 1943. The condition in his left eye had been present since birth.

Examination revealed that the right eye was normal, with visual acuity of 20/20.

The left eye had no light perception and was microphthalmic. The palpebral fissure of this eye was 2.5 mm. narrower than that of the right eye. Microcornea was also present, the vertical diameter being 8.75 mm. and the horizontal diameter 9.5 mm.

The left eye presented several anomalous features (fig. 7). First, the superior temporal quadrant of the cornea was the site of a fine relucence of the posterior layers, culminating in a more intense, small opacity at the apex of the quadrant near the center of the cornea. Several thick bundles of iris tissue formed anterior synechial attachments to the main posterior opacity, and at 3 o'clock a synechia, arising from the lesser circle of the iris, formed part of the opacity's sharp inferior margin. Over the entire extensive area no normal endothelium was seen.

The second feature of note was the absence of the lens. In its place appeared to be a pseudogliomatous mass, which in the main consisted of a gray-brown tissue, rimmed nasally by a border of white, which was adherent to the ciliary processes. The latter were seen nasally. The eye could not be transilluminated, an

Fig. 4 (case 3).—Diagrammatic sketch of the left eye. *A* indicates a corneal opacity; *B*, an anterior synechia, and *C*, a stromal defect in the iris.

indication of the extent of the process. The mass was in no place adherent to the cornea. No evidence of old inflammation was noted.

Here, too, no family history of a similar defect was obtained. A questionable story of injury at birth was given.

Six cases are presented in which the patients were born with opacities involving chiefly the deeper layers of the cornea to which anterior synechiae were attached. The opacities were of two types: one of greater density generally located either centrally or somewhat off center, and the other consisting of a peripheral membrane arising

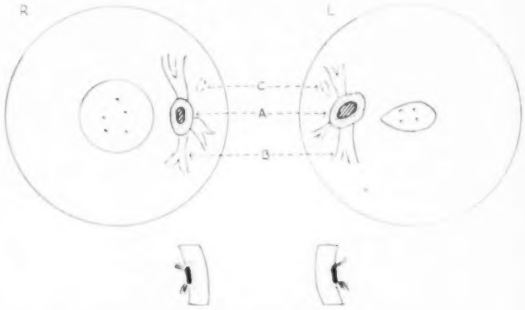

Fig. 5 (case 4).—Diagrammatic sketch of both eyes. *R* indicates the right eye; *L*, the left eye; *A*, a corneal opacity; *B*, an anterior synechia, and *C*, a stromal defect in the iris.

from tissue in the angle of the anterior chamber. As was to be expected, the central opacities produced impaired vision; the peripheral opacities did not. In no case was there evidence of inflammation. A familial incidence was present in 2

cases, as sisters were involved. In 1 of these 2 cases (case 2) both kinds of opacities occurred, the type differing in the two eyes. In case 4 bilateral symmetric opacities of the central, or first, type were seen, and in case 5, similarly distributed opacities of the peripheral type were noted. In case 6 the condition was complicated by the absence of the lens and the presence of pseudogliomatous tissue.

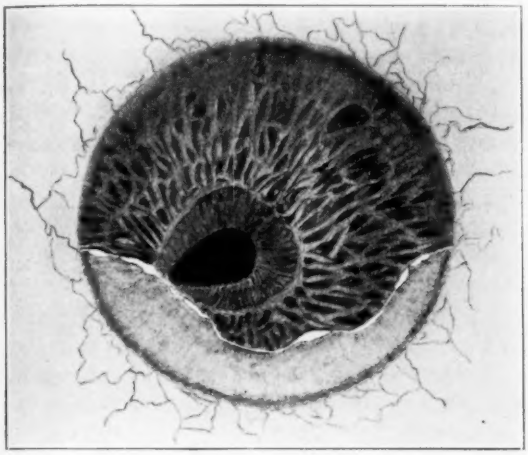

Fig. 6 (case 5).—Right eye. Drawing by Captain William H. Bonser, Medical Corps, Army of the United States.

The anterior synechiae arose for the most part from the angle of the anterior chamber, although some originated from the lesser circle of the iris. In every case, especially in the area corresponding to the corneal involvement, hypoplasia of the anterior, or mesodermal, layers of the iris was apparent. Marked corectopia was noted in the right eye in case 4 and dyscoria in the left eye in case 5.

In 3 instances (cases 1, 3 and 6) microphthalmos was present.

In view of the controversy concerning the origin of corneal opacities, these cases are of significance.

REVIEW OF LITERATURE

A review of the entire literature on corneal opacities with anterior synechiae is neither necessary nor feasible. Most of the important contributions, however, have been consulted.

It was natural for the earlier authors to attribute the condition to the end results of an external inflammatory process, notably ophthalmia neonatorum with perforation of the cornea. Ballantyne [1] mentioned cases described by von Beck in 1838, Samelsohn in 1880, Wintersteiner in 1893 and van Duyse in 1902 as illustrations of this point of view. While it is possible that the lesion might sometimes arise in this manner, such a theory can be considered tenable only in special instances.

At one time the theory that the abnormality was due to intrauterine inflammation had a considerable number of adherents. Perhaps the most outstanding proponent of this theory was von Hippel,[2] who termed the condition "internal ulcer of the cornea." Another protagonist was Ballantyne,[1] who published an extensive review in 1905. The basis of the theory was the observation of what appeared to be microscopic evidence of an old inflammatory process. It is probable that some cases do fall into this category, but, with increasing knowledge, it became evident that the presence of inflammation during fetal life could not explain the anomaly in most cases, as inflammatory signs were absent. Furthermore, the theory could not explain the hereditary tendency, the symmetry and bilaterality of the defect and the association with congenital anomalies of other parts of the body, as well as of the eye.

The only explanation left, therefore, was that corneal opacities with anterior synechiae, present from birth, arose as developmental defects. Among the most ardent advocates of this theory was Collins,[3] who, on the basis of clinical and pathologic studies, concluded that the cause lay in faulty development of the mesoderm that

Fig. 7 (case 6).—Diagrammatic sketch of the left eye. *A* indicates a deep corneal opacity; *B*, the pigmented portion of the pseudogliomatous mass; *C*, the ciliary processes; *D*, the stromal defect in the iris; *E*, anterior synechia, and *F*, the white portion of the pseudogliomatous mass.

1. Ballantyne, A. J.: Synechiae of the Iris and Pupillary Membrane, Tr. Ophth. Soc. U. Kingdom **25**:319, 1905.

2. von Hippel, cited by Duke-Elder,[12] p. 1282.

3. Collins, E. T.: Lectures on the Anatomy and Pathology of the Eye: Lecture III, Lancet **2**:1463, 1894; Adhesion of a Persistent Pupillary Membrane to the Cornea in the Eye of a Cat, Tr. Ophth. Soc. U. Kingdom **27**:203, 1907; Congenital Anterior Staphyloma, ibid. **29**:169, 1909.

grows in to form most of the cornea, including the endothelium and Descemet's membrane, the anterior chamber, the anterior portion and stroma of the iris and the trabecula. Collins expressed the belief that in most cases the defect was due to partial failure in formation of Descemet's membrane, with adhesion of the iris to the defective area. He postulated that congenital anterior staphyloma was due to complete failure of Descemet's membrane to appear, while he explained anterior synechia without opacifications as the result of failure of a small area of endothelium to differentiate in the presence of normal development of Descemet's membrane. Mayou [4] came to a similar conclusion.

In addition, Collins [5] reported the cases of 2 sisters in which bilateral corneal opacities were of such density as to obscure the irises. Moxon [6] also described congenital opacities in 2 sisters, but the irises were normal.

Important confirmation of the work of Collins was afforded by Seefelder,[7] who concluded that a developmental defect in Descemet's membrane occurs first and that adhesions are the result possibly of compression of the ingrowing pupillary membrane.

A different theory, based also on the concept of a developmental aberration, was advanced by Peters,[8] who called attention to the central location of the corneal defect and expressed the belief that the anomaly resulted from faulty separation of the lens vesicle from the surface ectoderm. He expressed the opinion that the ingrowing mesoderm was poorly developed and unable effectively to produce separation of the lens from the cornea. It is a criticism of Peters' theory that the lens usually reveals no important abnormalities, but Hoffmann [9] described a case that appeared to offer perfect corroboration of Peters' explanation. In each eye in this case the lens was luxated and was adherent to the back of the cornea at the site of a deep central opacity. In addition, a coloboma of the iris was present in each eye.

Berliner [10] described the cases of 2 cousins in which a so-called hyaline membrane on the posterior corneal surface, to which anterior synechiae were attached, was associated with syndactyly and microphthalmos. He expressed the belief that these cases were related to others previously reported by Ciotola,[11] who had studied the association of microphthalmos with other abnormalities of the body, as well as of the eye, and had asserted that such a clinical picture constitutes a definite syndrome. Berliner was chiefly concerned with this phase of the subject, but concluded that the lesion in his cases was unquestionably of congenital origin.

COMMENT

The 6 cases reported in this paper are interesting from several points of view. First, it is worth while merely to point out that corneal opacities with anterior synechiae may occur as a congenital anomaly, as many clinicians who first encounter such a lesion are likely to consider it the aftermath of an inflammatory process. It should also be mentioned that the anomaly, while not exceedingly rare, is not frequent, inasmuch as the 4 cases at Miami Beach Training Base were encountered during the examination of hundreds of thousands of men. In 2 other cases the condition appeared to have a similar origin but as the picture was not clearcut, the cases were not included in the report.

There can hardly be any doubt that the lesions in the cases presented in this paper arose from a developmental defect. Only in case 6 can any question be raised. In no instance was any evidence of inflammation present. In all cases the condition had been noted from birth. In cases 1 and 2, in which the lesions occurred in sisters, a familial tendency was indicated; in cases 2, 4 and 5 there was bilateral involvement, and in the last 2 cases a pronounced symmetry was evident. Microphthalmos, another congenital condition, was present in cases 1, 3 and 6. All these points suggest the congenital nature of the condition.

The cases are also significant because they offer additional confirmation of the theories of Collins and of Seefelder. One could hardly expect better clinical examples of the anomaly than the right eye in case 2 and both eyes in case 5, in

4. Mayou, M. C.: A Case of Congenital Synechiae with Buphthalmos (Anterior Staphyloma), Tr. Ophth. Soc. U. Kingdom **30**:120, 1910.

5. Collins, E. T.: Two Children in the Same Family with Congenital Opacities of Both Corneae, Tr. Ophth. Soc. U. Kingdom **30**:120, 1910.

6. Moxon, F.: Congenital Diffuse Non-Inflammatory Corneal Opacities in Two Sisters, Brit. J. Child. Dis. **2**:257, 1914.

7. Seefelder, R.: Pathologisch-anatomische Beiträge zur Frage der angeborenen zentralen Defektbildung der Hornhaut-Hinterfläche, Klin. Monatsbl. f. Augenh. **65**:539, 1920.

8. Peters, A.: Ueber angeborene Defektbildung der Descemetschen Membran, Klin. Monatsbl. f. Augenh. **1**: 27 and 105, 1906; Zur Frage der angeborenen Trübungen und Staphylome der Hornhaut, ibid. **70**:629, 1923.

9. Hoffmann, R.: Zur Entwicklungsweise der angeborenen Hornhaut-trübungen, Arch. f. Augenh. **105**: 162, 1932.

10. Berliner, M. L.: Unilateral Microphthalmia with Congenital Anterior Synechiae and Syndactyly, Arch. Ophth. **26**:653 (Oct.) 1941.

11. Ciotola, G.: Microftalmo e malformazione delle dita (sindattilia, polidattilia), Boll. d'ocul. **17**:855, 1938.

which the opacification was entirely peripheral. Moreover, in all but 2 of the cases the opacity, even if of the central type, began at the limbus. Again, for the most part the anterior synechiae arose peripherally, from deep in the angle of the anterior chamber. If the developmental fault lies with the mesoderm, which grows in from the periphery, the aforementioned abnormalities might readily occur. Moreover, the hypoplasia of the anterior layers of the iris, seen in all the cases; the corectopia, noted in case 5, and the dyscoria, observed in case 4, point to other mesodermal anomalies. Only in case 3, in which a fine anterior capsular cataract was noted, was there any special confirmation of Peters' theory.

Case 6 presents a somewhat more complicated problem. The corneal opacity, the anterior synechiae and the microphthalmos all point to a developmental aberration; yet one hesitates to place the absence of the lens on a congenital basis. True congenital aphakia is exceedingly rare and, as Duke-Elder [12] stated, tends to be associated with microphthalmos, as well as defects of the anterior segment. This author, however, mentioned several cases of aphakia without much deformity and credited Mann with a case of this condition in a fetus in which the cornea was only slightly thickened. Other explanations, aside from the obvious one of extrusion of the lens after trauma, include absorption of a congenital cataract, as recorded by Duke-Elder,[13] and absorption of the lens as a result of intrauterine inflammation. Either of the latter two mechanisms, as well as true congenital aphakia, may have occurred in case 6. The pseudogliomatous mass present in this case may have been the end result of such an inflammatory process, but in the absence of gross evidence it might better be considered of developmental origin.

12. Duke-Elder, W. S.: Text-Book of Ophthalmology, St. Louis, C. V. Mosby Company, 1938, vol. 2, p. 1346.

13. Duke-Elder,[12] p. 1374.

SUMMARY

Corneal opacities with anterior synechiae, 6 cases of which are reported, are of two types: one central and the other of peripheral origin. In 3 cases microphthalmos was present. In 1 case aphakia was also noted. In each case the condition had been present since birth.

Various theories as to the origin of the condition have been advanced. Its occurrence as a congenital anomaly due to faulty development of the ingrowing mesoderm that forms the corneal stroma, the endothelium, Descemet's membrane, the anterior layers of the iris and the trabecula is believed to be the most likely explanation of the condition. The cases reported appear to support this concept.

Another developmental theory ascribes the defect to incomplete separation of the lens vesicle from the surface ectoderm. A case cited bears out this belief. Other explanations base the defect on an inflammatory process, either intrauterine or postnatal.

It is believed that while all the theories are probably applicable in certain cases, the condition is due for the most part to a developmental anomaly of the mesoderm.

JUVENILE MACULAR EXUDATIVE CHOROIDITIS

JUVENILE DISCIFORM DEGENERATION OF THE MACULA (JUNIUS)

FRANCIS H. ADLER, M.D., AND HUNTER SCARLETT, M.D.
PHILADELPHIA

This is a report of 3 cases of macular disease which we believe most nearly fall under the diagnostic entity called juvenile macular exudative choroiditis, or juvenile disciform macular degeneration, described by Junius in 1930.[1] Because of the ease with which the disease may be mistaken for early malignant melanoma, the differential diagnosis of this condition is of some importance.

All the patients were young, healthy adults, in whose condition neither trauma nor any antecedent illness seemed to play a part. Their uniform complaint was a rather gradual depreciation of central vision in one eye only, which progressed within a matter of weeks until visual acuity was approximately 6/100, with an absolute central scotoma corresponding in size and shape to the ophthalmoscopically visible lesion in the macula.

The lesions when first seen were approximately the same in 2 cases. In the third case the lesion was older and was evidently undergoing absorption. The area in each case was somewhat oval, well circumscribed and pigmented and in places seemed to be covered with connective tissue. The color was not uniform throughout, but in some places was light gray and in others rather dark. Around the edges were a number of small hemorrhages, which seemed to come from under the pigmented mass. No difference in level could be made out between the mass and the surrounding retina, although the impression was that the mass was slightly elevated.

During the period of observation the only perceptible changes were the absorption of some of the hemorrhages and the appearance of fresh ones, always at the edge of the lesion. The pigmented mass itself changed somewhat; from time to time it seemed as though the amount of pigment shifted in a given area, and in 1 case the central pigment disappeared almost entirely. At no time was there any evidence of inflammation in the eye. There was no conjunctival or ciliary flush; no deposits on the posterior surface of the cornea; no floaters, or even a flare, in the aqueous; no cellular debris in the retrolental space, and no opacities in the vitreous. About the lesion itself there was no edema or exudative reaction such as one is accustomed to associate with true inflammatory lesions of the choroid. The eyeground presented no other lesions, of either present or past origin. The fellow eye was healthy in all cases. Except for a central scotoma, the fields were normal.

During a period of observation of six months to a year there was gradual but definite improvement of vision to 6/40 in 2 cases and to 6/12 in 1 case.

REPORT OF CASES

CASE 1.—H. M. W., a man aged 35, was referred by Dr. Norman L. Cutler, of Wilmington, Del., who had had him under observation since October 1941. At that time the patient had consulted Dr. Cutler for failing vision in the right eye for the preceding three weeks. His visual acuity, however, was then nearly 20/20. Within a week vision in the right eye had decreased to 20/70. When we first saw him it was 20/300. Vision in the left eye was 20/20, and this eye was entirely normal.

On external examination both eyes appeared normal. Examination of the anterior segment of the right eye with the slit lamp showed no evidence of inflammation. Ophthalmoscopic inspection of this eye showed that the media were clear. The disk was oval, of good color and well outlined. In the macula was a pear-shaped area, which was oval in the horizontal diameter, deeply pigmented and surrounded by deep hemorrhages. This area seemed to be raised, and the blood vessels coursed over it. There was no edema around it, and the rest of the fundus was normal.

Complete physical examination revealed nothing abnormal, and studies for foci of infection gave negative results. There was no history of injury, and no member of his family or any of his forebears, as far as he knew, had had any similar ocular trouble. The only positive observation was a mild degree of allergy to tuberculoprotein.

Since August 1942 there has been little change in the lesion. Some of the original hemorrhages have disappeared, and fresh ones have been noted from time to time. The central scotoma, which was present on the first examination, has decreased in size, and vision has improved from 20/300 to 20/100. At no time has there been any evidence of inflammation.

Figure 1 *A* shows the condition of the right eye in January 1943, and *B*, the appearance of the same eye in June 1943.

CASE 2.—Ensign W. J. P., a man aged 27, first noticed diminution of vision in the left eye in the latter part of December 1942. He had been present at the bombing

From the Department of Ophthalmology of the University of Pennsylvania.

Read at a meeting of the College of Physicians of Philadelphia, Section on Ophthalmology, April 15, 1943.

1. Junius, P.: Ztschr. f. Augenh. **70**:129, 1930.

of Pearl Harbor but was emphatic in his statement that he was nowhere near any explosions which could have affected him, even from blast. He had been seen by numerous Navy physicians and had finally been given permission to get civilian medical advice.

The right eye was entirely normal, with visual acuity of 20/20. Vision in the left eye was 20/300. The left eye was normal in every respect save for a pigmented lesion, oval and well circumscribed, in the macula, which was surrounded by several small hemorrhages. At first the lesion seemed elevated, and there was some question whether it might not be an early melanoma. The tension was 17 mm. in each eye and remained at about this level. No signs of inflammation were ever noted. Vision in the left eye gradually improved to 20/120, and the central scotoma was slightly smaller at the time of the last examination than it was at the first observation.

Fig. 1 (case 1).—*A*, condition of the right eye in January 1943; vision 20/300.

B, condition of the same eye in June 1943. The lesion itself was smaller, but there were numerous thin hemorrhages over the entire nasal side of the lesion, while those on the temporal side had disappeared. Vision was 20/100.

The history and the physical examination revealed nothing significant. All tests failed to show any possible cause of the lesion. The patient seemed to be exceptionally healthy. He has recently been given an honorable discharge from the Navy and was last seen on April 15, 1943.

Figure 2 shows the appearance of the lesion on Oct. 7, 1942.

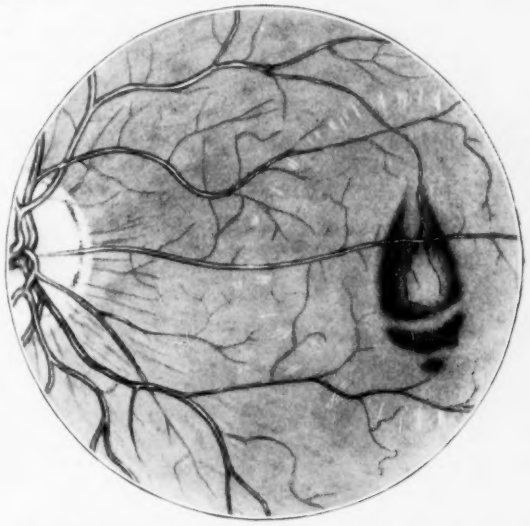

Fig. 2 (case 2).—Condition of the fundus of the left eye in October 1942; vision 20/300. Note the small, discrete hemorrhage below the lesion and the faint one adjacent to and on the temporal side of the lesion.

CASE 3.—M. L., a woman aged 30, noticed blurring of vision in the right eye on Christmas eve 1942. She was examined by several physicians and was seen by one of us (F. H. A.) in consultation with Dr. Harold Scheie, by whose permission we report her case.

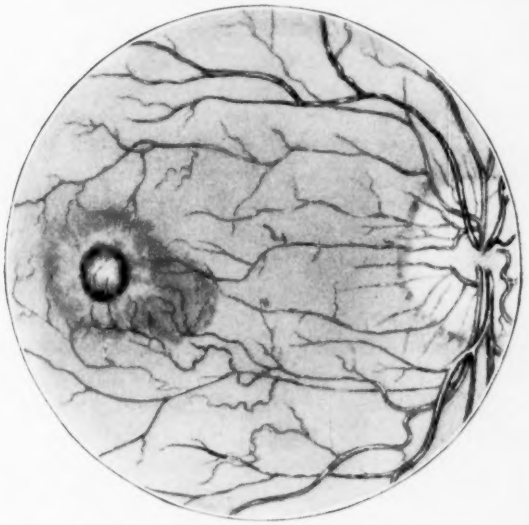

Fig. 3 (case 3).—Condition of the right eye in April 1943; vision 20/27.

On first observation vision was 20/50 in the right eye and 20/25 in the left, or normal, eye. The right eye was normal save for a macular lesion, which appeared to be in a later stage of disciform degeneration than

the lesions in the preceding 2 cases. In addition to the macular lesion, numerous yellowish, discrete areas, which looked like drusen, were scattered through the fundus of each eye. No inflammatory signs were present in either eye during our period of observation. A very small paracentral scotoma was present.

The lesion in this case had much less pigment than the lesions in the preceding 2 cases, and no hemorrhages were present. We cannot be sure that this case really belongs in this category, for physicians who had previously seen the patient stated that the area was one of subsiding choroiditis and that edema of the retina still persisted. When we saw her, however, no inflammatory signs were present, and the condition resembled disciform degeneration more than an old inflammatory lesion. Vision when she was last seen, on April 20, 1943, was 20/27 in the diseased eye. Figure 3 shows the appearance of the lesion on that date.

DIFFERENTIAL DIAGNOSIS

We shall consider the following diagnostic possibilities: (1) acute macular choroiditis, or central choroiditis; (2) tuberculosis of the macula and benign lymphogranuloma; (3) choroidal and subchoroidal hemorrhage in the macula; (4) nevus and malignant melanoma; (5) heredodegeneration and familial degeneration of the macula, and (6) juvenile macular exudative retinitis, or juvenile disciform degeneration.

Acute Macular Choroiditis.—Acute macular choroiditis has all the characteristics of similar isolated lesions in the other regions of the eyeground, but because of the anatomic peculiarities, the lesion is likely to be large and single. The lesion is highly exudative and invariably shows deposits on the corneal endothelium, floaters in the aqueous and opacities in the vitreous. In the early stages the lesions are nonpigmented and the retina is edematous. When the stage of atrophy begins, there is loss of the substance of the retina with exposure of the choroidal blood vessels, or of the bare sclera, and the pigment is nearly always distributed at the edges of the lesion, and not in the center.

It is true that Hepburn [2] pointed out that in the type of choroiditis which he designated as superficial, in contrast to the deep variety, there is often considerable proliferation of pigment over the surface of the patch, with heaping up of black masses, most of the pigment being retinal. Further, he stated that in this type there are less likely to be inflammatory signs, such as opacities in the vitreous, pain and sudden onset of visual loss—the condition coming on gradually and without any symptoms except for visual deterioration.

Hemorrhages are seldom seen in association with acute macular choroiditis and do not keep recurring when they are present. Once the lesion has fully formed, vision in that area is irretrievably lost.

Tuberculous Macular Choroiditis and Similar Lesions Due to Benign Lymphogranuloma.—The diagnosis of all tuberculous lesions of the uveal tract must be presumptive and is based on the ophthalmoscopic appearance of the lesion, its clinical course and the patient's degree of allergy to tuberculoprotein. This is also true of lesions supposedly due to sarcoid. All these lesions are highly exudative and so do not resemble the condition under discussion.

Choroidal and Subchoroidal Hemorrhage in the Macula.—Bedell [3] collected a large number of cases of choroidal hemorrhage in various regions of the fundus. Aside from cases of traumatic expulsive choroidal hemorrhage, which has nothing to do with the condition under discussion, he reported a number of cases of choroidal hemorrhages occurring in the macula. In some of these cases absorption of the blood was followed by abnormal pigmentation, often accompanied by a gray-white, closely adherent membrane, similar in appearance to the sheet of tissue in retinitis proliferans. In cases in which the blood was subchoroidal, Bedell claimed it could be differentiated from pigment by the latter's being darker, more homogeneous and more irregular in outline, with no great variations from time to time. Under the heading of choroidal hemorrhage Bedell included cases of senile macular degeneration, which, he asserted, is really choroidal hemorrhage in the later stages, when the blood is no longer visible as such. Moore [4] reported the case of a man aged 46 with a subchoroidal hemorrhage which contained some pigment, but the hemorrhage was massive and could not have been mistaken for anything else.

Heredodegeneration and Familial Degeneration of the Macula.—Many forms of so-called heredodegeneration and familial degeneration of the macula are described in the literature. There is no constancy in the ophthalmoscopic appearance of the macular lesions, and the diagnosis cannot be made from the fundic picture itself, but is based entirely on a family history that more than one member of the same family is similarly affected.

Heredodegeneration affects several generations, while with the familial type only the members of one generation have the disease, and the condition is not transmitted necessarily to the offspring. In none of our cases could it be

2. Hepburn, M. L.: Tr. Ophth. Soc. U. Kingdom **32**:361, 1911-1912.

3. Bedell, A. J.: Signfiicance of Choroidal Hemorrhage, Arch. Ophth. **8**:186 (Aug.) 1932.

4. Moore, F.: Tr. Ophth. Soc. U. Kingdom **30**:165, 1910.

learned that any other member of the family was similarly affected.

Nevus and Malignant Melanoma.—Choroidal nevus may occur in the region of the macula and is round, bluish or slate gray and usually slightly smaller than the disk. No hemorrhage or interference with visual acuity is present in cases of nevus. The lesion is congenital and usually does not change, although at any time it may begin to grow and become malignant.

The typical circumscribed malignant melanoma of the choroid is a small, lenticular or elliptic pigmented mass when it is first discovered; it may occupy any position in the fundus, although it is not common directly in the macula. Hemorrhage is not usual in the early stages but may be seen, and the presence of blood is not a sign that the lesion is not a melanoma. Further, inflammatory signs are frequent in the tumor, although this fact is not stressed in most textbooks. In fact, most texts deal almost entirely with the histologic appearance of this lesion and have little to say regarding its early appearance. As a result, a diagnosis of malignant melanoma is usually not made in regions like the macula, where transillumination is impossible until the tumor has attained considerable size and by its growth has shown its true nature.

Juvenile Macular Exudative Choroiditis, or Juvenile Disciform Degeneration of the Macula.—Junius was the first to describe this condition as a clinical entity. He stated that it was related to, but not identical with, the condition called "relapsing central retinitis" by von Graefe. The disease is characterized by the following features:

1. A slowly developing macular lesion, usually unilateral, in a young adult, with no history of trauma or antecedent disease.

2. A circumscribed lesion, usually lenticular or disklike, and containing considerable pigment early in the development of the lesion.

3. The absence of acute inflammatory signs.

4. The presence of hemorrhages surrounding the pigmented lesion and seeming to come from beneath it.

5. Gradual improvement in visual acuity. The vision may not return to normal, but usually improves to about 6/40.

Bailliart [5] reported a case of the disease in a woman of 25 in which the lesions were bilateral. In each macula was a lesion resembling a pigmented cyst, over the anterior surface of which the macular vessels passed. The cyst seemed to disappear, and the lesion then resembled a hole in the macula. The evolution of the condition in this case took less than three months, after which vision tended to improve. The illustrations which accompany Bailliart's case more nearly resemble the appearance of the lesions in our cases than any others we have found in the literature.

Wilmer [6] illustrated the early and late stages in 2 of his cases. His figures show a much more diffuse macular lesion than was present in our cases.

Few cases of this disease have been reported, probably because the condition has been regarded as ordinary macular choroiditis. The lesion is not common, of course—in fact, much less so than the similar lesion in older people, called senile disciform degeneration (Junius and Kuhnt). The cause of both the juvenile and the senile type of disciform degeneration differs from that of the highly exudative macular choroiditis and should be differentiated from it. Both forms of disciform degeneration are probably due to choroidal or subchoroidal hemorrhage, although the evidence for this in the case of the senile type is scant (Verhoeff and Grossman [7]) and the literature holds no evidence of this origin for the juvenile type, since none of the recognized cases of the disease were studied histologically.

SUMMARY

A condition with the characteristics of juvenile disciform degeneration of the macula, described first by Junius as juvenile macular exudative choroiditis, may be easily mistaken for an early malignant melanoma of the choroid. Recognition of this condition is therefore important.

Hospital of the University of Pennsylvania.

5. Bailliart, P., and others: Traité d'ophtalmologie, Paris, Masson & Cie, 1939, vol. 5, p. 386.

6. Wilmer, W. H.: Atlas Fundus Oculi, New York, The Macmillan Company, 1934.

7. Verhoeff, F. H., and Grossman, H. P.: Pathogenesis of Disciform Degeneration of Macula, Arch. Ophth. **18**:561 (Oct.) 1937.

EXPERIMENTAL STUDIES ON FATIGUE OF ACCOMMODATION

I. PLAN OF RESEARCH AND OBSERVATIONS ON RECESSION OF NEAR POINT OF ACCOMMODATION FOLLOWING A PERIOD OF INTERPOLATED WORK ON THE OPHTHALMIC ERGOGRAPH

CONRAD BERENS, M.D.
AND
SAUL B. SELLS, PH.D.
NEW YORK

The mechanism of accommodation has been the subject of much study and of much controversy. There is no agreement yet as to the exact mechanism of accommodation. There is evidence, however, that accommodation is subject to fatigue, i. e., decrease of power to accommodate resulting from prolonged exercise. Some authorities regard fatigue of the accommodative neuromuscular system as the central factor in the mechanism of ocular fatigue.

Positive results with respect to fatigue of accommodation have been reported by a number of investigators. Berens and Stark [1] reviewed the literature up to 1932. They discussed the positive findings of Ferree,[2] Lancaster and Williams [3] and Howe [4] and the work of Berens and his associates from 1918 on.[5]

Ferree,[2] using a method which consisted in observing the letters "li" on a white card set at a distance within the punctum remotum for a period of three minutes, recorded during this time the intervals of blurred and cleared vision. This test was given before and after periods of ocular work, and the two sets of results were compared. Ferree maintained that increase in the time that the test object was blurred after use of the eyes was the result almost entirely of changes in muscular control of the refracting mechanism. His explanation of these observations was

From the Department of Ophthalmology, New York University.

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1. Berens, C., and Stark, E. K.: (*a*) Studies in Ocular Fatigue: III. Fatigue of Accommodation; History, Apparatus, and Methods of Graphic Study, Am. J. Ophth. **15**:216, 1932; (*b*) Studies in Ocular Fatigue: IV. Fatigue of Accommodation; Experimental and Clinical Observations, ibid. **15**:527, 1932.

2. Ferree, C. E.: Tests for the Efficiency of the Eye Under Different Systems of Illumination and a Preliminary Study of the Causes of Discomfort, Tr. Illum. Engin. Soc. **8**:40 (Jan.) 1913.

3. Lancaster, W. B., and Williams, E. R.: New Light on the Theory of Accommodation with Practical Applications, Tr. Am. Acad. Ophth. **19**:170, 1914.

4. Howe, L.: Measurement of Fatigue of the Ocular Muscles, Tr. Sect. Ophth., A. M. A., 1912, p. 423; The Fatigue of Accommodation, as Registered by the Ergograph, J. A. M. A. **67**:100 (July 8) 1916; Varieties of Fatigue as Registered by Ergograph, Tr. Ophth. Soc. **15**: 145, 1917.

5. Berens, C.: The Manual of the Ophthalmologic Department, in Manual of the Medical Research Laboratory, Washington, D. C., Government Printing Office, 1918, p. 156; in Air Service Medical, Washington, D. C., Government Printing Office, 1919, p. 275. Berens, C.; Hardy, L. H., and Pierce, H. F.: Studies in Ocular Fatigue, in Contributions to Ophthalmic Science, Dedicated to Dr. Edward Jackson, Menasha, Wis., George Banta Publishing Co., 1926, p. 102; Studies in Ocular Fatigue: II. Convergence Fatigue in Practice, Tr. Am. Ophth. Soc. **24**:262, 1926.

challenged by Lancaster and Williams, who suggested that the blurring he noted was retinal in origin.

Lancaster and Williams [3] studied fatigue of accommodation both by sustained near fixation and by repeated determinations of the near point of accommodation following intervals of the reading of fine print. Although both the punctum proximum and the punctum remotum were generally brought nearer in their experiments, they obtained some curves in which a slight falling off of power to accommodate occurred after about one-half hour of continuous fixation.

Howe [4] adapted Mosso's ergographic method of studying fatigue of striated muscle to the study of fatigue of the ocular muscles. The first ophthalmic ergograph was described in 1912. Howe obtained typical fatigue curves by tracing the progressive recession of the blur point of the test object on a kymograph.

Berens and Stark,[1a] following Howe's pioneering efforts, refined the ergographic technic and produced a number of modifications and improvements of Howe's original model. These authors [1b] reported on a study of two groups of records made in the testing of fatigue of accommodation with the ophthalmic ergograph. In the first group, 165 qualified and 14 disqualified aviators were tested under low oxygen tension. More rapid recession of the near point of accommodation was found than when the subjects were under normal oxygen tension. A second group of 195 records of fatigue of accommodation in office patients, most of whom were asthenopic, showed variation in type of records. Fatigue of accommodation was not easily produced even in this group of patients. A high positive correlation was noted between the objective and the subjective evidence of fatigue of accommodation. Duane's tables for the near point of accommodation for various age groups were found to be an unreliable criterion of ability to accommodate without rapid fatigue.

The results of these experimental studies indicated that the ophthalmic ergograph could be used with success as a clinical instrument, both for diagnosis of easy fatigability of accommodation and for neuromuscular training.

With the exception of the one series of observations on subjects under conditions producing anoxemia, however, no evidence has yet been obtained relating to significant factors which cause fatigue. The experiments reported here are a continuation of Berens' earlier work. They were designed to evaluate the significance of a number of factors generally regarded as important in relation to ocular fatigue under carefully controlled experimental conditions. The factors selected for experimental study were (*a*) intensity of illumination, (*b*) types of test objects, (*c*) age and (*d*) visual task.

PLAN OF RESEARCH

A series of experiments was designed to study the effect of a visual task involving use of the ophthalmic ergograph on clinic patients with complaints of ocular fatigue or other symptoms of asthenopia.

A number of experimental factors were varied systematically in accordance with the plan shown in table 1. The different experimental conditions were controlled by the device of using the same patients for each of the 12 experimental tasks. This method makes possible direct comparisons on a constant population.

In these experiments, the ergograph task was extended to a limit of thirty minutes. This period was twice that employed in most previous experiments. The extension of time was considered most important because it was our belief that failure to obtain records of fatigue in many previous cases was due to inadequate work samples. The results reported here confirm this hypothesis.

Experimental Design.—Table 1 presents schematically the design of the research. Each subject was tested in 12 experimental situations. Experiment 1 consisted of an ergograph

task for the right eye only, the Berens astigmatic cross being used for near vision as a test object for accommodation under 5 foot candles of illumination. Before the ergograph task the subject was tested for muscle balance at 6 meters (far vision) and at 25 cm. (near vision) with the Maddox rod, and the near points of accommodation of the right eye, of the left eye and of both eyes were measured under 10 foot candles of illumination. After a brief pause for adaptation the ergograph task was administered for a period not exceeding thirty minutes. Then the final measurements of muscle balance and the near point of accommodation were made as before.

Experiments 2 and 3 were identical with experiment 1 except that the ergograph task was administered to the left eye in experiment 2 and to both eyes in experiment 3. Experiments 4, 5 and 6 followed the same plan except that in this series the test object was a line of letters on the Berens accommodation card. In experiments 7, 8 and 9 the astigmatic cross was used under 50 foot candles of illumination, and in experiments 10, 11 and 12 the letters were used under 50 foot candles of illumination.

TABLE 1.—*Diagrammatic Schema of Experimental Design, Showing Sequence of Experiments and of Tests at Each Experiment, and Experimental Conditions* *

	Illumination			
	5 Foot Candles		50 Foot Candles	
	Test Object		Test Object	
Eye	Cross	Letters	Cross	Letters
	Experiment 1	Experiment 4	Experiment 7	Experiment 10
Right	(*a*)	(*a*)	(*a*)	(*a*)
	(*b*)	(*b*)	(*b*)	(*b*)
	(*c*)	(*c*)	(*c*)	(*c*)
	(*d*)	(*d*)	(*d*)	(*d*)
	(*e*)	(*e*)	(*e*)	(*e*)
	Experiment 2	Experiment 5	Experiment 8	Experiment 11
Left	(*a*)	(*a*)	(*a*)	(*a*)
	(*b*)	(*b*)	(*b*)	(*b*)
	(*c*)	(*c*)	(*c*)	(*c*)
	(*d*)	(*d*)	(*d*)	(*d*)
	(*e*)	(*e*)	(*e*)	(*e*)
	Experiment 3	Experiment 6	Experiment 9	Experiment 12
Both	(*a*)	(*a*)	(*a*)	(*a*)
	(*b*)	(*b*)	(*b*)	(*b*)
	(*c*)	(*c*)	(*c*)	(*c*)
	(*d*)	(*d*)	(*d*)	(*d*)
	(*e*)	(*e*)	(*e*)	(*e*)

* In this table *a* indicates initial near point of accommodation (10 foot candles), right eye, left eye, both eyes; *b*, initial muscle balance; *c*, ergograph test (5 or 50 foot candles, 30 min.); *d*, final near point of accommodation (10 foot candles), right eye, left eye, both eyes; *e*, final muscle balance.

Selection of Subjects.—One hundred and fifty clinic patients were referred for testing. Of these, 57 who completed all tests constituted the population for the present report. These subjects ranged in age from 9 to 54 years and were distributed according to the following age groups:

Age, Yr.	Males	Females	Total No.
6-10	3	5	8
11-15	9	19	28
16-20	6	5	11
21-25	..	3	3
26-30	1	..	1
31-35	..	1	1
36-40	1	2	3
41-45	..	1	1
46-50	..	..	..
51-55	1	..	1
Total	21	36	57

The subjects were selected by the clinic ophthalmologist on the basis of symptoms of asthenopia and complaints of ocular fatigue. Patients with pathologic conditions of the eyes squint, etc., were not referred.

Refraction with cycloplegia was performed on all patients before the tests were begun, and they wore the recommended correction during the experiments. Normal vision of 20/20 was required, with manifest refraction showing not more than 1 D. of manifest hyperopia and 0.5 D. of hyperopic astigmatism, or with refraction with cycloplegia giving not more than 0.25 D. of myopia and 0.5 D. of myopic astigmatism.

The selection of clinic patients provided a homogeneous group with respect to socio-economic status.

High motivation was secured by the referring ophthalmologist by informing the patients that they were to receive exercises for the eye muscles. Because of this explanation, despite boredom and the inconvenience of their returning many times, the subjects were interested in knowing whether their "performance" was improving. A possible objection to this device is that patients have a tendency to want to improve and may thus delay the reporting of complete blurring or fatigue in later test sessions.

Apparatus.—The apparatus used in these experiments was an ophthalmic ergograph designed by one of us (C. B.)[6] for research (fig. 1). It was mounted on an adjustable table, which allowed accurate adjustment of height for each patient, as well as adjustment in height of the test object. This ophthalmic ergograph is the seventh reported by Berens.[6] With this instrument, the speed of forward and backward movement of the test

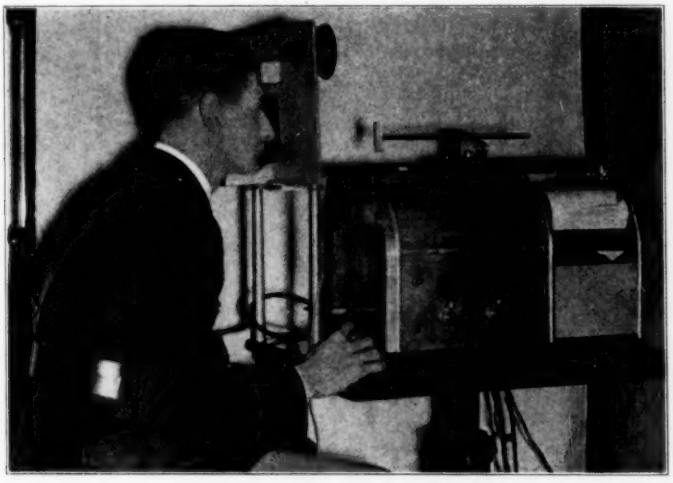


Fig. 1.—Accommodation ergograph.

object and the duration of the rest pause are controlled. The total range of movement of the test object carrier is 15 cm. A single motor drives the test object and the kymograph drum. The source of light is a single bulb mounted on the back of the screen above the chin rest, which projects light down on the test object carrier. This is a change from previous models, in which the light source was set on the test object carrier and was thus affected by the movements and vibration of the carrier. This ophthalmic ergograph is designed to reduce to a minimum all mechanical distraction and demands of mechanical control on the part of the subject. In addition to the change in method of illumination the following improvements were made: A new pen holder was devised for accuracy in recording; a shield of black cardboard was constructed in front of the recording device so that the patient was not distracted by the motion of the pen holder or by light reflecting in the vicinity of the ergograph; a Prince rule was set on the ergograph, and an opaque black cardboard screen was mounted before the ergograph, with an aperture so designed that it exposed to view only the test object. The light source was mounted on the inside of this screen; a chin rest and a head rest were substituted for the tongue depressor biting board previously employed. The tongue depressor was discarded because of the extreme discomfort to the subject during protracted, thirty minute test periods.

In the experiments reported here, the forward and backward speed of movement of the test object and the rest pause were constant throughout. The test object moved forward at

6. Berens, C.: An Accommodation Ergograph, Tr. Am. Acad. Ophth. **34**:472, 1929.

the rate of 2 cm. per second until stopped by the subject's pressing the control button (to indicate the point of blurring). Immediately after this, the test object returned to the point of origin at the same speed. The rest pause was two seconds.

Illumination.—Two experimental levels of illumination were used, 5 and 50 foot candles. These two levels were selected in order to obtain a noticeable difference within a practical range. A rheostat controlling the light source and a General Electric light meter mounted on the ergograph were used in calibration of the intensity of illumination at the following times: (1) at the start of each separate test session before measurement of the near point of accommodation for each eye separately and for both eyes; (2) during the test if any variation was noted in the mechanics of the setup for illumination; (3) if there was any change in the hum of the generator;[7] (4) if the patient remarked on any alteration in the lighting conditions, for example, fading or flickering, and (5) at the end of each test.

The illumination for measurement of the near points of accommodation and the muscle balance before and after each ergograph test was 10 foot candles.

During the period of rest between tests, the subject was given the choice of remaining in the darkened room or of having the room lighted artificially or by daylight.

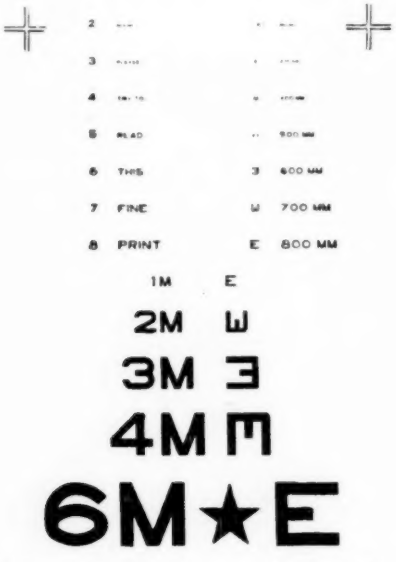


Fig. 2.—Accommodation test card; photographically reduced letters (Berens).

Test Objects.—The test objects used were the Berens astigmatic cross and photographically reduced letters on the Berens accommodation test card (fig. 2). These two types of test objects were selected because of their wide clinical use and because of their resemblance to visual material of importance in two significant life situations requiring fine near discrimination and accommodation. The cross resembles the crossed lines seen in gun and bomb sights. The letters are significant in reading.

Experimental Room.—The room was a small one with one window. During the tests, the window shades were drawn and a black cambric curtain was hung over the lower half. The transom was covered with a light-proof material. The walls were painted a dull pearl gray which had no important effect on the conditions of the test. Because of a building adjacent to the room the natural illumination was never great.

Experimental Procedure.—Each patient referred for study was examined for errors of refraction under cycloplegia before he reported for tests. At the first session the subject

7. The ergograph motor was on alternating current and the house current on direct current. The generator was used to convert the house current to alternating current. At certain times, when additional current was used elsewhere in the building, this caused a change in the exact level of illumination on the apparatus. Such changes were instantly recognized by a change in the sound of the generator.

was interviewed and the following preliminary information recorded: name; age at last birthday; sex; reading and visual habits; occupation and economic status, and visual complaint, based on the subject's own report. Data concerning visual acuity, correction to be worn during the experiment and results of refraction were provided from clinic records.

The experimenter explained the nature of the ergographic exercise to the subject and attempted to establish rapport with him by discussing his symptoms and giving him an opportunity to adjust to the test situation. Usually a preliminary demonstration of the ergograph was made.

At each experimental period the following procedure was observed:

1. The room was darkened, and muscle balance was determined at 6 meters, with a Maddox rod and prisms. Muscle balance was then taken at 25 cm.

2. A minute's rest was given, and then the subject was seated at the ergograph, wearing correcting lenses as prescribed. The correction was made with the use of trial frames if necessary.

3. The heights of the table, chair and test object were adjusted.

4. The near points of accommodation for the right eye, for the left eye and for both eyes under 10 foot candles of illumination were measured at the ergograph by the procedure already described. The test object for all these measurements was the astigmatic cross.

5. The subject was given a rest period of one minute, during which the illumination of 5 or 50 foot candles to be used during the ergograph experiment was calibrated.

6. The ergograph test was then administered for a period not exceeding thirty minutes. In a few cases the subject was permitted to continue slightly longer. The longest test recorded was thirty-nine minutes. The subject was instructed to remain silent during the test, to maintain fixation on the test object and to avoid movements of the head and body. Perfect compliance with these instructions was seldom obtained, and the experimenter recorded all deviations. Special instructions were given concerning the method of fixation. The subject was instructed to read the line of letters serially and to regard the cross, fixating its four arms in serial order. These instructions were designed to avoid retinal adaptation, which has often been confused with fatigue. At the end of the ergograph task the time was noted, and the reason for the subject's stopping was recorded as follows: L. R., limit reached; C. B., constant blur, or G. F., general fatigue or tiredness or inability to continue.

In cases in which the subject reported complete blurring of the test object his report was checked, to differentiate recession of the near point from purely visual fatigue, with a + 1.00 D. lens placed over his regular correction at the conclusion of the ergograph test. Most subjects reported improvement in ability to see the test object distinctly.

7. Immediately after this ergograph test the measurements of near point of accommodation under 10 foot candles of illumination were repeated.

8. After this, and after a rest period of one minute, the room was darkened slightly, and the measurements of muscle balance with the Maddox rod were repeated.

9. At the conclusion of experiment 1 the subject was allowed a rest period of at least five minutes, or until he had recovered completely from his blurring or fatigue and until the near point of accommodation had returned to normal. The same procedure was then repeated with the other eye (experiment 2) and then with both eyes (experiment 3). Whenever possible three tests with identical illumination and the same test object were given at a single sitting, unless there was excessive fatigue or the subject was unable to remain for sufficient time. The experimental arrangements were limited by the amount of time a subject had available. The complete experimental series required at least six hours of a subject's time. Each sitting averaged one and a half hours. The subject was requested to discuss his reaction after each test and often made a number of statements during the course of the test.

A standard setting of the distance, or base, position of the test object carrier was established for the experiments at the beginning of experiment 1. This was done by determining the near point of accommodation for each eye separately and then drawing the test object back 10 cm. from the average of these two points. The near points were determined in the following way: The test object was moved forward on the track manually by the experimenter, and the subject was instructed to report the moment the test object blurred. He was then asked to explain just what he perceived at this point. If the subject's response indicated that he understood the task, the same procedure was repeated four times and the median blur point calculated. Inasmuch as the range of movement of the test object carrier is 15 cm., this method provided for maximum forward movement of the test object to a point 5 cm. nearer the eye than the average of the near points of the two eyes. By this

procedure an objective check was provided on the subject's understanding of the ergograph task. The distance setting thus determined was used for all 12 experiments.

Instructions to Subjects.—Much attention was given to the instruction of the subjects in their task. The exact understanding of the blurring of the test object, and of how to recognize it and respond to it, is crucial to the successful interpretation of the results. Because of the differences in age, language background and intellectual level of the subjects tested, it was found impractical to use standard instructions for each subject. In general the instructions took the following form: "The cross seen before you will blur when it is close to your eyes, and you should indicate when it blurs by pressing the button. If there is a change in the condition of your eyes, that is, if you feel tired or if the cross blurs, you are to report this to me." This statement was repeated and elaborated as much as the experimenter thought necessary before the experiment was begun. The subject was instructed to look at the object carefully both as it came toward him and as it receded and to report any change in its appearance. The subject usually reported that it disappeared as it came up close. He was then asked to watch it several times and to report any change immediately before it disappeared. He usually reported: "it blurs"; "it gets fainter"; "I can't see it so well"; "there are two of them"; "the lines get fuzzy"; "the lines fade"; "it looks like it gets under water." If the subject did not use the word "blur," he was asked if at any time he noticed the test object blur. If he had, he was asked to explain what he meant by "blur." If necessary, the meaning of blur was explained in terms of change in the appearance of the test object. The subject was cautioned against waiting until the test object had disappeared and was instructed in the difference between blurring and doubling. The criterion of blurring was distinguished from that of disappearance.

The subject was instructed to hold his head steady in the chin and head rests and to fixate the test object continuously without shifting his gaze. Special instructions were given for fixating both the letter and the cross. In fixation of the cross he was told to fix on the quadrants of the cross in a clockwise fashion, counting them off 1, 2, 3, 4, silently. In fixation of the letters he was told to fix on each letter of the appropriate line serially.

The line of type read was the smallest line on the accommodation card which the subject could read easily at 10 to 14 inches (25 to 35 cm.). At first the entire card was exposed, and the subject was instructed to fixate the line read as previously described. Soon after the beginning of the experiments a mask was prepared which exposed only the line read.

The subject was instructed to press the button at the point of blurring on each forward trip of the carrier and to follow the test object on its return. He was instructed to give as detailed a subjective report as possible.

RESULTS

Recession of Near Point of Accommodation Following a Period of Interpolated Work on the Ophthalmic Ergograph.—In this paper the results of the 12 experiments for the entire group of 57 patients are presented with respect to changes in the near point of accommodation following the ergograph test. The specific data analyzed are the measurements of the recession of the near point of accommodation, separately for the right eye, for the left eye and for both eyes, under 10 foot candles of illumination after each ergograph test. This recession is expressed as the difference between the initial and the final mean near point. A statistical test of the significance of this difference is analyzed for evidence of fatigue of accommodation. This is the first study of ocular fatigue in the literature in which the work decrement is evaluated by a statistical test of significance. Earlier authors drew conclusions concerning the occurrence or nonoccurrence of fatigue on the basis of the analysis of so-called fatigue curves. In a later paper in this series it will be shown that evidence of fatigue, expressed as a decrement between the initial and the final near point of accommodation separated by an interpolated period of work on the ophthalmic ergograph, is obtained in many cases in which a typical "fatigue curve" does not occur.

In subsequent papers we shall present additional data in analysis of the effect of the various experimental factors: intensity of illumination; types of test objects; age, and visual task, with an analysis of the ergographic records and data relating to error of refraction, dominant eye and visual acuity, together with a more detailed analysis of individual cases.

Experiment 1 consisted of an ergograph test for the right eye only, with the left eye occluded; the experimental test object was the astigmatic cross, and the illumination, 5 foot candles. Table 2 presents the mean and the standard deviation of the initial and the final near points of accommodation, the mean differences and the critical ratios of the differences for each eye separately and for both eyes.

The test of significance used to evaluate the reliability of the differences between the initial and the final means is a critical ratio obtained by dividing each difference ($M_F - M_I$) by the standard error of that difference ($S.D._{Diff.}$). A critical ratio of 1.64 indicates that the probability that a difference as great as that obtained could have occurred by chance is 95 chances in 100. The probability is 99 in 100 for a ratio of 2.20 and 99.9 in 100 for a ratio of 3. For a ratio of 5, it is 99.99997133 in 100. Most statisticians accept the 95 per cent value as reliable and the 99 per cent value as extremely reliable. A detailed treatment of this method may be found in the text by Peters and Van Voorhis.[8]

The initial and final means for the right eye are 10.49 and 13.37 cm. respectively. The difference is 2.88 cm., which is 6.13 times the standard error of the difference. The initial and final means for the left eye are 10.91 and 12.49 cm. respectively. The difference is 1.58 cm., which is 4.27 times the standard error of the difference. The initial and final means for both eyes are 9.46 and 11.04 cm. respectively. The difference is 1.58 cm., which is 4.39 times the standard error of the difference. The magnitude of the corresponding critical ratios indicates that these differences could not have occurred by chance. The difference is greatest for the right eye, as is the critical ratio for that difference.

TABLE 2.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 1; right eye; cross; 5 foot candles) *

Eye	Initial N. P. A.		Final N. P. A.		Difference ($M_F - M_I$)	Critical † Ratio (D/S.D. Diff.)
	Mean	Standard Deviation	Mean	Standard Deviation		
Right	10.49	2.49	13.37	4.53	2.88	6.13
Left	10.91	2.91	12.49	4.03	1.58	4.27
Both	9.46	2.31	11.04	3.25	1.58	4.39

* In this table, and in the accompanying tables, the values represent data obtained with the ergograph test on a total of 57 subjects who completed all the tests. The near points of accommodation are always expressed in centimeters.

N. P. A. indicates near point of accommodation; M_F, final mean; M_I, initial mean; D, difference; S.D., standard deviation of distribution and Diff., difference.

† The following formula was used in computing all critical ratios:

$$C.R. = \frac{\text{Difference } (M_F - M_I)}{S.D._{(Diff.)}}, \text{ in which } S.D._{(Diff.)} = \sqrt{S.D._{M_I}^2 + S.D._{M_F}^2 - 2r_{IF}\, S.D._{M_I}\, S.D._{M_F}}$$

(Peters and Van Voorhis,[8] chap. V and VI.)

Tables 3 through 13 are identical in design with table 2. They show the results of experiments 2 through 12 respectively. All of the differences reported are statistically significant. The interpretation of these tables follows exactly the same pattern as that of table 2. In general, the difference in means is greatest and the critical ratio is highest for the working eye (or working eyes, when both eyes were tested together).

In experiment 2 the difference in the means is greatest for the left eye, as is the corresponding critical ratio. It is noted that similar differences and critical ratios were obtained for the right eye and for both eyes (table 3).

8. Peters, C. C., and Van Voorhis, W. R.: Statistical Procedures and Their Mathematical Bases, New York, McGraw-Hill Book Company, Inc., 1940, chap. 5 and 6.

In experiment 3, although the difference between the initial and the final mean is greatest for the left eye, the range of the three differences in means is only 0.25 cm. (table 4). The critical ratio is greatest for the difference in the means for both eyes.

TABLE 3.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 2; left eye; cross; 5 foot candles)

Eye	Initial N. P. A.		Final N. P. A.		Difference ($M_F - M_I$)	Critical Ratio (D/S.D. Diff.)
	Mean	Standard Deviation	Mean	Standard Deviation		
Right	10.68	4.24	12.47	4.26	1.79	2.80
Left	10.81	2.58	13.61	4.78	2.80	5.72
Both	9.98	2.66	11.25	3.82	1.27	2.89

TABLE 4.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 3; both eyes; cross; 5 foot candles)

Eye	Initial N. P. A.		Final N. P. A.		Difference ($M_F - M_I$)	Critical Ratio (D/S.D. Diff.)
	Mean	Standard Deviation	Mean	Standard Deviation		
Right	10.75	3.94	12.60	4.15	1.85	3.25
Left	10.60	2.53	12.70	4.48	2.10	2.84
Both	10.21	2.93	12.25	5.31	2.04	3.65

TABLE 5.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 4; right eye; letter; 5 foot candles)

Eye	Initial N. P. A.		Final N. P. A.		Difference ($M_F - M_I$)	Critical Ratio (D/S.D. Diff.)
	Mean	Standard Deviation	Mean	Standard Deviation		
Right	11.02	2.95	13.56	5.03	2.54	5.19
Left	10.80	2.82	12.75	4.51	1.86	4.53
Both	10.02	2.94	11.97	4.42	1.95	5.00

TABLE 6.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 5; left eye; letter; 5 foot candles)

Eye	Initial N. P. A.		Final N. P. A.		Difference ($M_F - M_I$)	Critical Ratio (D/S.D. Diff.)
	Mean	Standard Deviation	Mean	Standard Deviation		
Right	11.23	3.17	13.02	4.30	1.79	4.84
Left	11.25	3.29	13.79	4.85	2.54	6.05
Both	10.51	3.18	11.89	4.47	1.38	3.94

In experiment 4 the difference between the initial and the final mean is greatest for the right eye, as is the critical ratio for that eye. The differences in the means and the critical ratios are similar for the left eye and for both eyes (table 5).

In experiment 5 the difference between the initial and the final mean is greatest for the left eye, as is the critical ratio for that eye (table 6).

In experiment 6 the difference between the initial and the final mean is greatest for both eyes, as is the corresponding critical ratio. The differences in the means and the critical ratios for the right and the left eye are approximately equal (table 7).

TABLE 7.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 6; both eyes; letter; 5 foot candles)

Eye	Initial N. P. A.		Final N. P. A.		Difference ($M_F - M_I$)	Critical Ratio (D/S.D. Diff.)
	Mean	Standard Deviation	Mean	Standard Deviation		
Right	10.84	2.54	12.18	4.41	1.34	3.83
Left	10.88	2.83	12.25	4.72	1.37	3.34
Both	10.46	3.02	12.16	4.74	1.70	4.47

TABLE 8.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 7; right eye; cross; 50 foot candles)

Eye	Initial N. P. A.		Final N. P. A.		Difference ($M_F - M_I$)	Critical Ratio (D/S.D. Diff.)
	Mean	Standard Deviation	Mean	Standard Deviation		
Right	10.96	2.81	12.77	4.61	1.81	4.90
Left	11.00	3.06	12.35	4.48	1.35	3.30
Both	10.05	2.78	11.89	4.35	1.84	4.00

TABLE 9.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 8; left eye; cross; 50 foot candles)

Eye	Initial N. P. A.		Final N. P. A.		Difference ($M_F - M_I$)	Critical Ratio (D/S.D. Diff.)
	Mean	Standard Deviation	Mean	Standard Deviation		
Right	10.67	3.14	12.44	5.19	1.77	3.85
Left	10.89	3.11	13.14	5.04	2.25	5.00
Both	10.12	2.78	11.75	4.10	1.63	3.70

TABLE 10.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 9; both eyes; cross; 50 foot candles)

Eye	Initial N. P. A.		Final N. P. A.		Difference ($M_F - M_I$)	Critical Ratio (D/S.D. Diff.)
	Mean	Standard Deviation	Mean	Standard Deviation		
Right	10.67	3.13	12.65	4.88	1.98	4.95
Left	10.67	3.29	12.56	4.64	1.89	4.72
Both	10.00	3.09	12.44	5.42	2.44	5.95

In experiment 7, although the difference between the initial and the final mean is greatest for both eyes, it is only 0.03 cm. greater than that for the right eye. The critical ratio is greatest for the right eye. The difference in means is least for the left eye, as is the critical ratio for that eye (table 8).

In experiment 8 the difference between the initial and the final mean is greatest for the left eye, as is the critical ratio for that eye (table 9). The differences in the means for the right eye and for both eyes are similar.

In experiment 9 the difference between the initial and the final mean is greatest for both eyes, as is the corresponding critical ratio. The differences in the means and the critical ratios for the right eye and for the left eye are smaller and are approximately equal (table 10).

In experiment 10 the difference in the means is greatest for the right eye, as is the critical ratio for that eye (table 11).

In experiment 11 the difference between the initial and the final mean is greatest for the left eye, but the critical ratio is greatest for the right eye (table 12). The

TABLE 11.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 10; right eye; letter; 50 foot candles)

	Initial N. P. A.		Final N. P. A.			
Eye	Mean	Standard Deviation	Mean	Standard Deviation	Difference ($M_F - M_I$)	Critical Ratio ($D/S.D._{Diff.}$)
Right	10.54	2.71	13.09	4.83	2.55	6.22
Left	10.40	2.82	12.30	4.66	1.90	4.87
Both	9.80	2.08	11.61	4.26	1.81	4.52

TABLE 12.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 11; left eye; letter; 50 foot candles)

	Initial N. P. A.		Final N. P. A.			
Eye	Mean	Standard Deviation	Mean	Standard Deviation	Difference ($M_F - M_I$)	Critical Ratio ($D/S.D._{Diff.}$)
Right	10.56	2.28	12.28	4.14	1.72	5.40
Left	10.53	2.87	12.96	5.17	2.43	5.40
Both	9.91	2.64	11.75	4.13	1.84	5.10

TABLE 13.—*Comparison of Mean Initial and Final Near Points of Accommodation for the Right Eye, for the Left Eye and for Both Eyes* (experiment 12; both eyes; letter; 50 foot candles)

	Initial N. P. A.		Final N. P. A.			
Eye	Mean	Standard Deviation	Mean	Standard Deviation	Difference ($M_F - M_I$)	Critical Ratio ($D/S.D._{Diff.}$)
Right	10.54	3.25	12.21	4.75	1.67	3.71
Left	10.58	3.05	12.35	5.18	1.77	3.94
Both	9.82	2.83	12.42	6.26	2.60	4.26

critical ratio of 57.40 is accounted for by a correlation of 0.94 between the initial and the final near point of accommodation.

In experiment 12 the difference between the initial and the final mean is greatest for both eyes, as is the corresponding critical ratio. The differences in the means and the critical ratios for the right and the left eye are approximately equal (table 13).

COMMENT AND SUMMARY OF RESULTS

1. Evidence of Occurrence of Fatigue of Accommodation.—The results of a partial analysis of 12 experiments on the fatigue of accommodation with use of the Howe-Berens ophthalmic ergograph which have been reported are concerned with evidence of the occurrence of such fatigue; the data analyzed are differences

between mean near points of accommodation computed from measurements of near points taken for the 57 subjects, at 10 foot candles of illumination, immediately before and after each ergograph experiment.

The initial and final mean near points of accommodation for the right eye, for the left eye and for both eyes were compared for each experiment, and critical ratios were obtained by dividing each difference in the means by the standard error of the difference. Of the 36 critical ratios so computed, 33 were greater than 3. The three remaining ratios were 2.80, 2.84 and 2.89 respectively. In terms of probability, a critical ratio of 3 means that the chances are 99.9 in 100 that the difference obtained could not have occurred by chance. A critical ratio of 2.80 indicates that the chances are greater than 99 in 100 that the observed difference did not occur by chance.

We conclude, then, that the differences between all initial and final mean near points are statistically significant. Because of the experimental design, we conclude, further, that the differences represent a recession of the near points as a result of the interpolated periods of exercise on the ophthalmic ergograph. This is regarded as evidence of fatigue of accommodation.

2. Differential Effects on the "Working Eye" and the Occluded Eye.—Experiments 1, 4, 7 and 10 were performed on the right eye, with the left eye occluded. In experiments 1, 4 and 10 the difference between the initial and the final mean point of accommodation was greater for the right eye than for the left eye or for both eyes, and the corresponding critical ratios were similarly greater. The difference in means was greatest for both eyes in experiment 7, but this difference was only slightly larger than that for the right eye.

Experiments 2, 5, 8 and 11 were performed on the left eye, with the right eye occluded. In all 4 of these experiments the differences in the means for the left eye exceeded greatly those for the right eye and for both eyes. The corresponding critical ratios for these differences were distributed in the same relations in experiments 2, 5 and 8.

Experiments 3, 6, 9 and 12 were performed on both eyes. The differences in means in experiments 6, 9 and 12 were greatest for both eyes. The difference in the means for the left eye was slightly greater than that for both eyes in experiment 3. All critical ratios for both eyes were highest in this series.

These results confirm the expectation that both eyes will manifest fatigue, even when only one works while the other is occluded. The effect is differential, however, and the "working eye" loses accommodative power temporarily (fatigues) to a greater extent than the other, which merely accommodates reciprocally because of neuromuscular interaction.

Miss Alice Gilman administered the experiments reported.

35 East Seventieth Street.

OPHTHALMIC REQUIREMENTS OF THE MILITARY SERVICES

CHANGES FROM FEB. 1, 1943 TO JAN. 1, 1944

CHARLES A. BAHN, M.D.
NEW ORLEANS

At the request of the American Committee on Optics and Visual Physiology, the following changes are presented. For details the reader is referred to the original article.[1]

SELECTIVE SERVICE

Sections 1, 2 and 3 are unchanged.

ARMY

In section 1, requirements indicated under the headings "Vision," "Refraction," "Color Vision" and "Muscles" are unchanged except for the following regulation, which applies to enlisted personnel, general service:

Binocular vision (both eyes open) of not less than 20/40, without glasses, provided vision in the more defective eye is not less than 20/70 without glasses, correctable or uncorrected, and provided the defective vision is not due to organic disease.

Section 2 is unchanged.

Section 3 is unchanged except for the authority for the new regulation in section 1.

Letter from the War Department, Army Service Forces, Office of the Surgeon General, Washington, D. C., Nov. 15, 1943.

NAVY, MARINE CORPS AND MERCHANT MARINE

Section 1.—The functional requirements for enlisted and commissioned personnel, male and female, in the Navy, Marine Corps and Merchant Marine are as follows:

	Vision				Color Vision (Tests Conducted with Pseudoisochromic Plates for Testing Color Perception; American Optical Company or Stilling Test)
	Without Glasses		With Glasses		
	One Eye	Other Eye	One Eye	Other Eye	
1. Enlisted personnel..... Navy (regular), Marine Corps (regular)	15/20	15/20	20/20	20/20	Must read one plate of each of the following groups of American Optical Company* plates: (1) plates 1, 2, 3, 4; (2) plates 7, 8, 9, 10, 13, 14, and (3) plates 17, 18, 21, 22 (these groups are represented in Stilling's twentieth edition† by plates 3, 4 and 8)
Navy (reserve), Marine Corps (reserve)	6/20	10/20	No lens correction necessary		Same requirements as for regular enlisted personnel; defective color perception may be waived for induction or enlistment in class V6 (Seabees)
	No organic disease				
	[Binocular]				
Waves (Navy); Marine Corps; Women's Reserve, class VI (a)	6/20	12/20	20/20	20/20	Same requirements as for regular enlisted personnel
	No organic disease; defective vision not due to organic disease and correctable to 20/20 may be waived locally				
Inductees in Navy and Marine Corps	6/20	10/20	No lens correction necessary		Same requirements as for regular enlisted personnel
	Or 10/20 binocular with minimum of 6/20 in either eye; no organic diseases				
Inductees for special assignment	2/20	2/20	10/20	10/20	Color blindness acceptable
	Will accept slight functional defects				
2. Commissioned officers; line officers of Navy, regular and reserve (D = V [G] and DE = V [G] only) and line and staff officers of Marine Corps, regular and reserve	18/20	18/20	20/20	20/20	Must be able to read all pseudoisochromatic plates of American Optical Company or Stilling test
3. Commissioned officers (staff), civil engineers, Supply Corps, Medical Corps, Nursing Corps, Dental Corps and Chaplain Corps; line officers of Naval Reserve for special service; Seabees; commissioned Waves and commissioned officers of Marine Corps Women's Reserve	12/20	12/20	20/20	20/20	Must complete one of the two tests
4. Aviation officers, Navy and Marine Corps (involving actual control of aircraft)	20/20	20/20	.....	.....	Must complete one of the two tests
5. Naval Academy	20/20	20/20	.....	.....	Must complete one of the two tests
	No myopia or myopic astigmatism with homatropine cycloplegia				
6. Enlisted Reserve (potential officers): Class V1-G, class V1-S, class V7-G, class V7-S	Enlistments in these classes have been discontinued				
Class V-5.....	20/20	20/20	.....	.....	
Class V-12, class V-12 (S), class SV-7 (S), class SV-12 (S) Midshipmen of Merchant Marine	18/20	18/20	20/20	20/20	Must complete one of the two tests
7. Merchant Marine, class M-1, M-2	Enlistments in these classes have been discontinued				

* American Optical Company: Pseudo-Isochromatic Plates for Testing Color Perception, Southbridge, Mass., American Optical Company, 1940.

† Stilling, J.: Stillings pseudo-isochromatische Tafeln zur Prüfung des Farbensinnes, ed. 20, Leipzig, G. Thieme, 1939.

From the Department of Ophthalmology, Medical Center, Louisiana State University School of Medicine.

1. Bahn, C. A.: (*a*) Ophthalmic Requirements of the Military Services, Arch. Ophth. **27**:1202-1213 (June) 1942; (*b*) **29**:831 (May) 1943.

The last footnote on page 6 of the Feb. 1, 1943 revision of "Ophthalmic Requirements of the Military Services" (page 836 [1b]) has been modified as follows:

The classes open for enlistment in the United States Naval Reserve are as follows: V5, aviation cadets for flight training; SV-7(S), pretheological students; V6 and V6SV, enlisted reserve; V9, enlisted Waves; V10, officer candidate Waves; V12, SV-12, V-12(S) and SV-12(S), men enlisted for Navy College Training Program.

The classes open for enlistment in the United States Marine Corps Reserve are as follows: III (b), enlisted and reenlisted men; SS III (b), transfers from induction; IV, limited duty, guard duty in the United States only; V (b), specialist reservists; VI (a), women officer candidates, and VI (b), women enlisted.

The conditions of the eye listed on pages 4 and 5, section 2, paragraphs A and B of the Feb. 1, 1943 revision of "Ophthalmic Requirements of the Military Services" (page 834 [1b]) apply to inductees in the United States Navy and the United States Marine Corps.

There are no changes in section 2, page 7, of the Feb. 1, 1943 revision of "Ophthalmic Requirements of the Military Services" (page 837 [1b]) relative to the disqualifying conditions and diseases for enlisted and commissioned personnel.

References 4, 5, 6, 7 and 8 on page 7, section 3 of the Feb. 1, 1943 revision of "Ophthalmic Requirements of the Military Services" have been canceled (page 837 [1b]), and the following references should be added:

1. Recruiting Circular Letter 7-43 Procurement Directive 6-43, Jan. 28, 1943.
2. Recruiting Circular Letter 24-43, June 1, 1943, United States Navy Department: enclosure C.
3. Recruiting Circular Letter 25-43, June 16, 1943, United States Navy Department: enclosure A.
4. Conference call to all officers of Naval Officer Procurement, June 5, 1943, United States Navy Department.
5. The Commandant, United States Marine Corps, letter of July 28, 1943 to the Officer in Charge of Procurement Divisions.
6. Bureau of Naval Personnel Letter, United States Navy Department, to the Navy Recruiting Service of May 26, 1943, Pers-620-RS, 5-26-43.
7. Bureau of Naval Personnel Letter, United States Navy Department, of Sept. 4, 1943, Pers-626-ACK.
8. Headquarters, United States Marine Corps Letter of July 24, 1943 to Officer in Charge of Procurement Division, MC-91894 1865-20 DHD-509-RSW.
9. Recruiting Circular Letter 28-43, July 13, 1943, United States Navy Department.
10. Headquarters, United States Marine Corps Letter, June 12, 1943, reference 1535-85 DHD-274-RSW (no serial number).
11. Headquarters, United States Marine Corps Letter of Instruction, Feb. 11, 1943, 1535-85 AQ-311-rwg.

COAST GUARD

Sections 1, 2 and 3 are unchanged.

AIR CORPS: ARMY AND NAVY

The requirements are unchanged except for those pertaining to the Army Air Corps.

The minimum requirements for visual acuity for aviation cadet training (air crew) and for officer training in grade (air crew) are 20/30, correctable to 20/20 in each eye. The efficiency of the extrinsic ocular muscles may permit esophoria of 12 D., exophoria of 7 D, and power of divergence of 2 to 15 prism diopters, equal to or greater than the number of diopters of esophoria. This test is accomplished at 20 feet (6 meters). Corrected depth perception is 35 mm.

The foregoing regulation has the following authority:

Relaxation in Physical Standard Requirements of Applicants for Air Crew Training, United States War Department, Circular 176.

UNITED STATES PUBLIC HEALTH SERVICE

The requirements are unchanged.

The committee acknowledges the cooperation and assistance of Surgeon General Norman T. Kirk and Lieutenant Colonel G. E. Gorman, of the Army, and Surgeon General Ross T. McIntire, of the Navy.

1703 Pere Marquette Building.

Clinical Notes

PENICILLIN IN TREATMENT OF GONORRHEAL CONJUNCTIVITIS

Report of a Case

WALTER P. GRIFFEY, M.D., NEW YORK

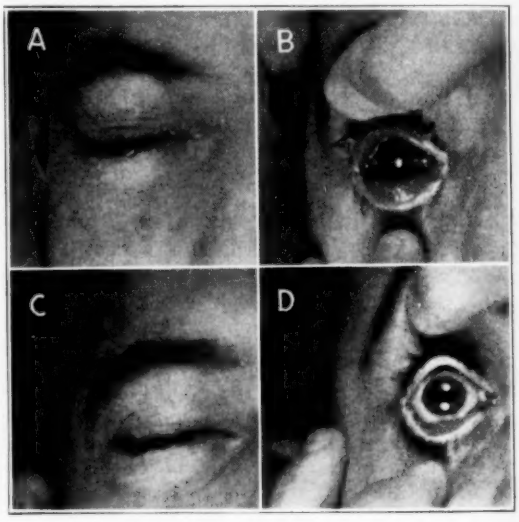
V. R., a man aged 24, was admitted to the United States Marine Hospital, Staten Island, N. Y., on July 3, 1943. He stated that a urethral discharge was observed on May 18, three days after sexual exposure. About four days subsequent to the appearance of the urethral discharge the patient noticed that the right eye was inflamed. On May 24 he was admitted to the United States Marine Hospital at Brighton, Mass., where the diagnoses of gonorrheal urethritis and gonorrheal conjunctivitis (of the right eye) were recorded. Sulfathiazole therapy was instituted, and sulfathiazole ointment, boric acid and cold compresses were applied locally. Bacterial vaccine made from the typhoid bacillus U. S. P. was given intravenously. The oral use of sulfathiazole was continued until July 2, at which time the urethral discharge had subsided considerably but the ocular infection, with a copious purulent discharge, persisted.

The appearance of the right eye at the time of admission to this hospital is shown in *A* and *B* of the accompanying figure. Spreads of the exudate from the conjunctival sac disclosed gram-negative intracellular diplococci, which were identified as gonococci by culture studies. The gonococcus was also identified by culture of sediment from the urine.

Therapy consisted of intramuscular injections of 25,000 units of penicillin sodium every three hours for a total of ten injections. The drug was dissolved in distilled water; the gluteal muscles were the sites of injection, and a 1½ inch (3.8 cm.) 22 gage needle was employed.

As a means of observation of the bactericidal effect of the therapy, hourly examinations of spreads and cultures of the conjunctival secretions were made. Both were recorded as positive for Neisseria gonorrhoeae for five hours, after which the results of examination were persistently negative. Specimens of urine were obtained at the beginning of therapy, three hours later and, again, five and one-half hours after institution of treatment. Cultures of sediment of the specimen taken at the beginning of treatment and of that obtained three hours after treatment had begun were recorded as positive for the organism. The culture of sediment from the specimen collected five and one-half hours after the beginning of treatment was recorded as negative. Subsequent studies of prostatic secretions gave uniformly negative results.

The clinical response was prompt. Approximately ten hours after the beginning of penicillin therapy the exudate of the eye had greatly diminished, and after the inflammation subsided the eye returned to normal.



A and *B*, appearance of the eye before, and *C* and *D*, appearance after, treatment with penicillin.

No other medication was used except for the instillation of a 1 per cent solution of atropine sulfate. At the time of discharge from the hospital vision in the left eye was 20/20 and the eye was normal. Vision in the right eye was 20/20 with correction with a +0.25 D. sphere. *C* and *D* of the figure show the appearance of the eye after treatment.

The bacteriologic studies reported here were made by Dr. J. Durward Thayer, Venereal Disease Research Laboratory, United States Marine Hospital, Staten Island, N. Y.

From the United States Public Health Service.

This study was undertaken at the request of the Committee on Chemotherapeutic and Other Agents, Division of Medical Sciences, National Research Council, acting for the Committee on Medical Research of the Office of Scientific Research and Development. The penicillin was furnished through a contract between the Office of Scientific Research and Development and the Massachusetts Memorial Hospitals.

COMPARISON OF THE ISHIHARA AND THE AMERICAN OPTICAL COMPANY SERIES OF PSEUDOISOCHROMATIC PLATES

CAPTAIN ROBERT H. HARRIS, MEDICAL CORPS, ARMY OF THE UNITED STATES

It has been noted that aviation cadet applicants sometimes pass the American Optical Company series of pseudoisochromatic plates but fail the Ishihara series. Fourteen hundred and seventy-one applicants for air crew training were examined by use of the 32 plate Ishihara series, followed by the 46 plate American Optical Company series. The applicant failed if he missed 25 per cent or more of the plates in each book.

It was found that 6.6 per cent, or 100, failed the Ishihara series, and 5.7 per cent, or 83, the American Optical Company series. Only 5 of the 83 who failed the American Optical Company series could not trace the gray-blue line in plate 45 of that series, and only 13 of the 100 candidates who failed the Ishihara series did not trace the two gray-blue lines in plates 30 and 31. Fifty-seven of the 83 candidates who failed the American Optical Company series missed a number in one or both of the gray-blue–numbered plates 33 and 34 of that series. Forty of the 100 candidates who failed the Ishihara series missed a number in one or more of the gray-blue–numbered plates, 18, 19, 20 and 21. These are the plates more easily read by persons who show some degree of color blindness, but they are usually read as blanks by applicants who have normal color vision. The ratio of candidates confusing the darker red with the brighter red in plates 22, 23, 24 and 25 in the Ishihara series was about 2 to 1.

One of the 17 men who passed the American Optical Company series received a perfect score but failed on 9 of the Ishihara plates, and another of these 17 men failed to read numbers in plates 32 and 34 of the American Optical Company series, although he read all the rest of the plates correctly, but failed on 18 of the Ishihara plates. Confusion of the number 3 with 8 or 5, of 7 with 2, of 4 with 1, of 9 with 8, of 7 with 9, of 6 with 8 or of 3 with 8 was noted many times with persons who had normal color perception.

Line plate 27 of the Ishihara series was passed by only 4 and line plate 29 by only 2 of the 100 candidates who failed in this series. The use of these plates alone therefore would have resulted in detection of a larger proportion of color-blind applicants than employment of all the tests in the American Optical Company series. Line plate 35 in the American Optical Company series was passed by 50 and line plate 36 by 15 of the 100 candidates who failed in the Ishihara series.

Acknowledgment of familiarity with the American Optical Company plates was obtained from some examinees. This series seemed more available for study than the Ishihara series. Some applicants who had previously failed in the color vision test returned after they had gained familiarity with the plates and requested another examination. Repeated color vision tests make possible better scores even when the order of presentation of the plates is varied. The examinee may fail when he first sees the plates, but on reexamination his score is improved. The ideal method is presentation of an unfamiliar series to the applicant, but this is not always possible. Attempts to check the history of previous familiarity with the American Optical Company series was met with evasion by many candidates who failed the Ishihara series but passed the American Optical Company series.

It has been recommended that in the examination of applicants for flying training the milder grades of color blindness should be detected and the candidates eliminated. Familiarity with tests does not mean improvement of deficient color vision. The examinee should be reexamined once. Nervous tension decreases the applicant's efficiency in reading the test. If he realized he was failing, his efficiency decreased. An applicant who was disqualified because of deficient color vision, if not previously aware of the defect, was usually more perturbed than by any other disqualification during the examination.

Because the line plates are placed at the end of the Ishihara book and are more time consuming, a candidate who fails more than 25 per cent of the plates before reaching this point is examined more rapidly. The line plates of the Ishihara series are much more efficient than the line plates of the American Optical Company series. The reason for the difference in efficiency of the duplicate line plates of the Ishihara and the

American Optical Company series is probably the difference in the artist's conception of color intensity. From the results in these tests the human eye seems to be the only factor concerned in testing and standardizing the color intensity of the plates. The perfect choice of varying color intensities in the Ishihara book leaves little to be improved on.

A few suggestions for improvement of the Ishihara plates from the standpoint of mass efficiency may be made:

Plate 1 of the book should consist of large ½ to 1 inch (1.27 to 2.54 cm.) circles of pure red, green and orange and varying shades with a white background. This plate could be used to distinguish pure red and pure green.

Plates 18 and 19, the two plates with blue-gray single numbers, as well as plate 39, with gray-blue lines, should be eliminated as superfluous.

Plate 32 should be placed before plate 26 as an instruction plate.

Test books for color vision should be stored in places where they not only are not exposed to light, but are not available for study by prospective color-deficient candidates.

CONCLUSIONS

The Ishihara series of plates seemingly meets the demands of mass efficiency better than the American Optical Company series because less time is consumed in the examination, elimination of candidates with subnormal color perception is more thorough and the book is less easily available to color-deficient candidates who wish to become familiar with it for the purpose of passing the examination.

Ophthalmologic Reviews

EDITED BY DR. FRANCIS HEED ADLER

PENICILLIN AND GRAMICIDIN AS OCULAR CHEMOTHERAPEUTIC AGENTS

WAYNE W. WONG, M.D

CHICAGO

The discovery of two new chemotherapeutic agents from microbial sources has recently been reported. Their clinical application in treatment of local and systemic infections has demonstrated their effective antibacterial action, which appears to be more potent than that of any known chemotherapeutic agent. The few published reports regarding their utilization in ophthalmology have been somewhat dramatic; however, it appears from the small number of cases reported that the therapeutic potentialities of these agents have not been fully recognized by ophthalmologists.

The observation made by Pasteur and Jouber [1] in 1877 that the infective power of the anthrax bacillus was decreased when its growth was contaminated by certain saprophytic bacteria is apparently the first report of the phenomenon of antagonism between different microbial species. The therapeutic value of microbial antagonism was soon recognized, for by 1900 several reports appeared in regard to the use of an extract from cultures of Pseudomonas pyocyanea in the treatment of a variety of local infections. However, the great toxicity of this extract rendered it of little practical value.

In 1929 Fleming [2] observed that a strain of Penicillium notatum, a fungus, growing as a contaminant on nutrient agar plates, inhibited the growth of pyogenic cocci. This antagonistic activity was traced to a soluble principle, penicillin, present in the culture filtrates of the organisms. Fleming noted that the addition of penicillin to nutrient broth or agar inhibited the growth of most gram-positive organisms, whereas the gram-negative organisms remained unaffected. He further observed that the injection of broth containing penicillin was no more toxic to mice than plain broth, and he therefore suggested that this substance might be a useful antiseptic for application to infected wounds. Nothing further was reported concerning this substance until Chain and his associates,[3] in 1940, published their studies on the nature, properties and clinical advantages of penicillin.

The production of penicillin in therapeutic quantities is a long and tedious process. In 1941 Abraham and his co-workers [4] published their method for the mass production of this substance. Briefly described, their method is as follows: Batches of fifty vessels, each vessel containing 1,000 cc. of medium, are set up daily. These are autoclaved for an hour and inoculated on the following day with a spore suspension derived from subcultures of a strain of Penicillium used by Fleming. The greatest care is taken to avoid contamination, as even very small numbers of certain bacteria can reduce the yield of penicillin to the vanishing point. In about ten days the growth covers the surface of the medium, at which time the liquid containing the penicillin is drawn off. From this crude liquid, therapeutic penicillin is extracted with amyl acetate and purified by multiple chemical processes. About 100 liters of medium is required to produce 1 Gm. of therapeutic penicillin.

Penicillin has not yet been obtained in its crystalline form,[5] but spectrographic studies made by Holiday [6] revealed that the limit of purity of this substance thus far obtained has not been reached. It is readily soluble in organic solvents, is easily destroyed by acid reactions and is

From the Department of Ophthalmology, Cook County Hospital.

1. Pasteur, L., and Jouber, J.: Compt. rend. Acad. d. sc. **85**:101, 1877; cited by Dubos, R. J.: Bacteriostatic and Bactericidal Agents Obtained from Saprophytic Microorganisms, J. Pediat. **19**:588-595, 1941.

2. Fleming, A.: On the Antibacterial Action of Cultures of Penicillium with Special Reference to Their Use in the Isolation of B. influenzae, Brit. J. Exper. Path. **10**:226-236, 1929.

3. Chain, E.; Florey, H. W.; Gardner, A. D.; Heathley, N. G.; Jennings, M. A.; Orr Ewing, J., and Sanders, A. G.: Penicillin as a Chemotherapeutic Agent, Lancet **2**:226-228, 1940.

4. Abraham, E. P.; Chain, E.; Fletcher, C. M.; Gardner, A D.; Heathley, N. G.; Jennings, M. A., and Florey, H. W.: Further Observations on Penicillin, Lancet **2**:177-188, 1941.

5. Abraham, E. P., and Chain, E.: Purification and Some Physical and Chemical Properties of Penicillin, Brit. J. Exper. Path. **23**:103-115, 1942.

6. Holiday, G. L.: Spectrographic Examination of Penicillin Preparation, Brit. J. Exper. Path. **23**:115-119, 1942.

fairly stable in the form of the sodium or the barium salt.

Purified penicillin has an extremely powerful bacteriostatic action.[7] It is capable of inhibiting the growth of Staphylococcus aureus at a dilution of between 1 : 24,000,000 and 1 : 30,000,000. The standard of activity is the so-called Oxford unit, which may be defined as the amount of penicillin per milligram just capable of inhibiting a growth of Staph. aureus at a dilution of 1 : 50,000. Nothing is known of its mode of action, but it appears to prevent cellular division and gives rise to giant forms. The morphologic changes occurred even when the concentration of penicillin had no bacteriostatic effects.[8] No harmful effects on the blood elements have been reported.[9] Hobby and her associates[10] observed that under experimental conditions the number of organisms decreased at a constant rate, the rate at which they were killed varying with different organisms. From these experiments they were unable to detect any destruction or absorption of penicillin by the organisms. Penicillin is not inhibited by serum, tissue extracts or products of tissue breakdown, and in this respect it is superior to the sulfonamide compounds.[11] When the substance was given intravenously, approximately half the material was excreted into the urine, without evidence of renal damage.[12] None was detected in the spinal fluid or the tears.[13] On the basis of present evidence, it appears that the substance should be most useful in the treatment of infections with Staph. aureus, Streptococcus pyogenes, Diplococcus pneumoniae, Neisseria gonorrhoeae and Neisseria intracellularis, as well as organisms associated with gas gangrene. It has no effect on the acid-fast bacilli or the virus of influenza.[8]

Technical difficulties in the preparation of this material have to a large degree retarded the widespread clinical use of penicillin. However, a little more than 20 cases have been reported in which treatment with this substance was successful. These cases have primarily been instances of severe septicemia.[14] However, the Oxford group of workers[4] included 4 cases of ocular infection in their series. A summary of these cases may be interesting in revealing the nature of the ocular conditions and the manner in which penicillin was used.

Case 1.—A woman aged 32 had a history of a corneal ulcer of the left eye for the past four months. This was treated by instillation of colloidal silver, solution of boric acid, merbromin and ultraviolet rays. Under this treatment the ulcer resolved in six weeks. However, three weeks later a similar ulcer developed in the right eye. This was treated along similar lines for six weeks, without improvement. The patient was then admitted to the hospital, and examination showed an infiltrating ulcer of the cornea, located in the inner and upper quadrants of the limbus. There were gross injection of the conjunctiva and considerable corneal opacity. Cultures of material from the eye yielded Staph. aureus. Treatment was started with instillation into the eye of a 1 : 5,000 dilution of sodium penicillin in saline solution every hour by day and every two hours by night. After two days of this treatment there was little visible progress; so continuous application was deemed necessary. A modification of the Bunyan-Stannard bag was made to fit the eye and a 1 : 5,000 solution of sodium penicillin run into it. (This is the bag that is used in the envelope method of treatment of burns, as reported by Bunyan.[15] No details are given as to the exact method by which the bag was modified to fit the eye and the means by which the lids were kept opened.) After one day of continuous application there was less injection of the conjunctiva and the patient was free from pain for the first time. On the second day the concentration of sodium penicillin in the saline solution was raised to 1 : 1,000, but this caused slight irritation; so for the next two days a 1 : 2,500 dilution was used. By the end of the fourth day the eye was greatly improved; the conjunctiva was only slightly injected, and the corneal opacity had almost disappeared. The deep ulcer remained but was considerably smaller. Treatment was then continued with hourly drops of the 1 : 2,500 solution, and after one day this concentration was increased to 1 : 500, "therapeutic penicillin," which caused no discomfort. Eight days after the initial use of penicillin, the ulcer no longer stained with fluorescein, but there was still slight injection. Treatment was then continued with drops of a 1 : 500 solution of sodium penicillin every two hours by day and every four hours by night, but further improvement was slow. After eight days of this treatment the patient had only a slight residual infiltration of the conjunctiva, which cleared up a week later.

Case 2.—A girl aged 19 had an infected cigaret burn of her face of six weeks' duration. A week before admission her left eye became red, swollen and painful. On admission she was found to have impetiginous lesions

7. Hobby, G. L.; Meyer, K., and Chaffee, E.: Activity of Penicillin in Vitro, Proc. Soc. Exper. Biol. & Med. **50**:277-280, 1942. Chain and others.[3] Abraham and others.[4]

8. Robinson, H. J.: Toxicity and Efficacy of Penicillin, J. Pharmacol. & Exper. Therap. **77**:70-79, 1943.

9. Herrell, W. E.: Further Observations on the Clinical Use of Penicillin, Proc. Staff Meet., Mayo Clin. **18**:65-76, 1943.

10. Hobby, G. L.; Meyer, K., and Chaffee, E.: Observations on the Mechanism of Action of Penicillin, Proc. Soc. Exper. Biol. & Med. **50**:281-285, 1942.

11. (*a*) Hobby, G. L.; Meyer, K., and Chaffee, E.: Chemotherapeutic Activity of Penicillin, Proc. Soc. Exper. Biol. & Med. **50**:285-288, 1942. (*b*) Chain and others.[3] (*c*) Abraham and others.[4]

12. (*a*) Herrell, W. E.; Heilman, D. H., and Williams, H. L.: Clinical Use of Penicillin, Proc. Staff Meet., Mayo Clin. **17**:609-616, 1942. (*b*) Hobby, Meyer and Chaffee.[11a]

13. Rammelkamp, C. H., and Keefer, C. S.: The Absorption, Excretion and Distribution of Penicillin, J. Clin. Investigation **22**:425-437, 1943.

14. Abraham and others.[4] Herrell.[9] Herrell and others.[12a]

15. Bunyan, J.: Envelope Method of Treating Burns, Proc. Roy. Soc. Med. **34**:65, 1940.

on both sides of the face. The conjunctiva of the left eye was inflamed and showed a thick mesh of fine vessels; the cornea was clear. The eye bag used in the previous case was filled with a 1:2,500 solution of sodium penicillin, and continuous application was started. On the following day there was less injection, and the eye was not painful. After three days of this treatment the eye was almost normal; treatment was then continued with drops of a 1:500 solution of sodium penicillin every two hours by day and every four hours by night for one day, after which the eye was considered normal.

CASE 3.—A man aged 24 had a foreign body removed from his left eye, after which acute conjunctivitis developed. The condition was treated with a solution of boric acid, zinc lotion and colloidal silver, and the lids were painted with silver nitrate. There was only slight improvement after ten days of this treatment. Treatment with drops of sodium penicillin resulted in rapid improvement and complete relief of pain in two days. This treatment was continued for ten days longer, when healing was complete.

CASE 4.—A woman aged 20 had acute mucopurulent conjunctivitis. The condition was treated with boric acid and zinc lotion, and the lids were painted with silver nitrate. There being no improvement after two days of this treatment, drops of penicillin were used, and the eye was regarded as healed in five days.

From these cases one may conclude that penicillin resulted in rapid relief of pain and resolution of inflammation in certain ocular conditions, without any harmful effects on the eye.

Penicillin proved to be more effective in the treatment of experimentally produced staphylococcic ulcers of the cornea than a 15 per cent solution of soluble sulfathiazole or a 30 per cent solution of sodium sulfacetimide. Robson and Scott [16] obtained staphylococci from human lesions which in preliminary tests on rabbit eyes consistently produced corneal lesions. A dilution of a culture of the organisms thus obtained was injected into the cornea to make a small bleb under the epithelium. In each animal, one eye was treated with the appropriate chemotherapeutic agent, while the other eye was similarly treated with saline solution. The treatment was first applied one hour after inoculation and was continued hourly for the next forty-eight hours and thereafter at less frequent intervals. A 30 per cent solution of sodium sulfacetimide proved more effective than sulfathiazole but not as effective as penicillin under these conditions. These results are not surprising in the light of the observations of some workers [17] that local application of sodium sulfacetimide in rabbits produced a greater concentration in the aqueous than sulfathiazole. From these experiments one may conclude, at least experimentally, that the ocular penetration of penicillin is so great that it is more effective than any known sulfonamide compound.

Although the number of cases reported is small in which penicillin has been of value in the treatment of certain ophthalmic conditions, the drug is nevertheless a welcome addition to the limited means of treatment of recalcitrant corneal ulcers.

Roberts and his co-workers [18] extracted another form of penicillin from the culture medium of strains of Penicillium notatum. This substance, which they called penicillin B, is not soluble in organic solvent, in contrast to the original penicillin. It is highly active against gram-positive, as well as gram-negative, organisms. Recent work [19] has shown it to be a protein with an enzymic action, the antibacterial properties of which are attributed to the liberation of hydrogen peroxide as one of the products of its enzymic action. It is relatively stable in its dry state and a great deal more potent than original penicillin; the growth of Staph. aureus is inhibited in a dilution of 1 part in 6,000,000,000. Unfortunately, penicillin B is toxic for mice when injected subcutaneously, as 0.25 mg. causes death in from three to twenty-four hours. However, larger quantities are tolerated when repeated smaller injections are made, an indication that the substance has no cumulative toxicity. At any rate, its potency, stability and apparent polyvalent activity may prove useful clinically, at least for local application in certain ocular conditions.

Dubos [20] isolated a soil bacterium capable of producing a substance which caused lysis of living gram-positive cocci. His discovery was the result of a systematic attempt to discover microorganisms that would attack the living cells of gram-positive cocci. To achieve this end, he used suspensions of living streptococci and staphylococci to which were added the soil mixture, in the hope that they would develop in the soil sample a microbial flora which would be antagonistic to the organisms used. By such methods he was able to isolate a strain of Bacillus brevis, an aerobic, sporulating organism, which pro-

16. Robson, J. M., and Scott, G. I.: Effect of Certain Chemotherapeutic Agents on Experimental Eye Lesions Produced by Staphylococcus Aureus, Nature, London **149**:581-582, 1942.

17. Robson, J. M., and Scott, G. I.: Local Effectiveness of Sodium Sulphacetamide, Brit. M. J. **1**:5-8, 1942. Chinn, H., and Bellows, J. G.: Corneal Penetration of Sulfanilamide and Some of Its Derivatives, Arch. Ophth. **27**:34-39 (Jan.) 1942.

18. Roberts, E. C.; Cain, C. K.; Muir, R. D.; Reithel, F. J.; Garby, W. L.; Jones, L. R., and Dorsey, E. A.: Penicillin B: An Antibacterial Substance from Penicillium notatum, J. Biol. Chem. **147**:47-58, 1943.

19. Van Bruggen, J. T.; Reithel, F. J.; Cain, C. K.; Katzman, P. A., and Doisy, E. A.: Penicillin B: Preparation, Purification, and Mode of Action, J. Biol. Chem. **148**:365-378, 1943.

20. Dubos, R. J.: Bactericidal Effect of an Extract of a Soil Bacillus on Gram-Positive Cocci, Proc. Soc. Exper. Biol. & Med. **40**:311-312, 1940.

duced a soluble principle that was extremely toxic to gram-positive bacteria. By means of differential treatments of an autolyzed culture of B. brevis a precipitate, tyrothricin, is obtained. On further extraction of this precipitate with acetone and ether, two crystalline products are obtained.[21] One of these substances has been called gramicidin on account of its selective bacteriostatic and bactericidal effect against gram-positive micro-organisms. The other substance is called tyrocidin because it is rich in the amino acid tyrosine. Tyrothricin[22] is composed of 15 per cent gramicidin and 85 per cent tyrocidin hydrochloride.

In spite of their common origin and the fact that both these substances are polypeptides,[23] gramicidin and tyrocidin differ not only in other chemical properties but in biologic activity. Tyrocidin behaves like a general protoplasmic poison and affects both gram-positive and gram-negative organisms. However, it loses much of its antibacterial activity in the presence of animal tissues, besides being hemolytic.[24] Gramicidin, on the other hand, is completely inactive against gram-negative bacilli, moderately active against meningococci and highly inhibitory to practically all the gram-positive species so far tested, with the exception of the acid-fast bacilli. Gramicidin does not seem to affect the growth and behavior of animal cells in tissue culture,[25] nor is its action decreased by products formed in necrotic tissues.[26] When given intravenously it is very toxic to dogs and mice. It is possible that its hemolytic action may in some way contribute to its toxicity in the blood stream. On the other hand, it appears to exhibit less toxicity when applied locally—for instance, on the mucous membranes. When it is used in open wounds that are fairly deep, there is the danger of absorption and possible hemolytic action.[27] Its subcutaneous and intradermal use should be abandoned, as such injections produced local nodules which remained unabsorbed for five to six weeks.[28] When it is given orally[29] to dogs, it has no toxic or therapeutic effect, even after the administration of quantities one hundred and sixty times the amount capable of killing the tested organisms in vitro. The reason for the oral ineffectiveness of gramicidin, is either that it is destroyed by the digestive ferments, as it is a polypeptide,or that its action is inhibited by fecal material. Its remarkable bacteriostatic action is shown by the fact that 0.001 mg. of the substance injected intraperitoneally is sufficient to protect mice against 10,000 fatal doses of pneumococci or group A streptococci.

The clinical reports available reveal that gramicidin has been primarily used topically. In their 12 cases Herrell and Heilman[27] used the crude substance tyrothricin, which they found experimentally to have essentially the same bactericidal effect as that of gramicidin, although it may not be as active. Other investigators[30] noted a definite bactericidal effect against streptococci in cases of bovine mastitis.

The only report of the clinical use of this substance in ocular therapeutics is that of Bellows.[31] He noted that a suspension of tyrothricin greater than 0.5 per cent produced considerable irritation, and even cloudiness, of the cornea of rabbits. He was unimpressed with its clinical trial in several cases of acute conjunctivitis. Similar observations have been made by Robinson and Molitor,[28] who noted that when tyrothricin in a 0.5 per cent concentration in saline solution was used in the conjunctival sac of albino rabbits, there was no evidence of irritation. However, when the dry material was dusted into the conjunctival sac, there was pronounced irritation characterized by chemosis and corneal opacity, which were present twenty-four hours after instillation. The use of an inert powder, barium sulfate, in a similar manner did not produce such effects.

21. Dubos, R. J., and Hotchkiss, R. D.: The Production of Bactericidal Substances by Aerobic Sporulating Bacilli, J. Exper. Med. **73**:629-640, 1941.

22. Hitchkiss, R. D., and Dubos, R. J.: The Isolation of Bactericidal Substances from Cultures of Bacillus Brevis, J. Biol. Chem. **141**:155-162, 1941.

23. Hotchkiss, R. D.: Chemical Nature of Gramicidin and Tyrocidine, J. Biol. Chem. **141**:171-185, 1941. Christensen, H. N.; Edwards, R. R., and Piersme, H. D.: The Composition of Gramicidin and Tyrocidin, ibid. **141**:187-195, 1941.

24. Rammelkamp, H. C., and Weinstein, L.: Hemolytic Effect of Tyrothricin, Proc. Soc. Exper. Biol. & Med. **48**:147-149, 1941.

25. Heilman, D. H., and Herrell, W. E.: Comparative Antibacterial Activity of Penicillin and Gramicidin: Tissue Culture Studies, Proc. Staff Meet., Mayo Clin. **17**:321-327, 1942.

26. Ferraro, W. R.: Comparative in Vitro Effects of Gramicidin and Sulfathiazole on Staphylococcus Aureus, Bull. New York M. Coll., Flower & Fifth Ave. Hosps. **5**:164-173, 1942.

27. Herrell, W. E., and Heilman, D. H.: Experimental and Clinical Studies on Gramicidin, J. Clin. Investigation **20**:583-591, 1941. Rammelkamp and Weinstein.[24]

28. Robinson, H. J., and Molitor, H.: Some Toxicological and Pharmacological Properties of Gramicidin, Tyrocidine and Tyrothricin, J. Pharmacol. & Exper. Therap. **74**:75-82, 1942.

29. Weinstein, L., and Rammelkamp, C. H.: A Study of the Effect of Gramicidin Administered by Oral Route, Proc. Soc. Exper. Biol. & Med. **48**:147-149, 1941.

30. Little, R. B.; Dubos, R. J., and Hotchkiss, R. D.: Action of Gramicidin on Streptococci of Bovine Mastitis, Proc. Soc. Exper. Biol. & Med. **44**:444-445, 1940.

31. Bellows, J. G.: Chemotherapy in Ophthalmology, Tr. Am. Acad. Ophth. **47**:19-33, 1942.

In the present state of ignorance, nothing is known of the mode of action of gramicidin. Dubos [32] isolated another bacterial substance from the soil which was capable of decomposing the capsular wall of pneumococci, and in this manner rendered them susceptible to phagocytosis. The action of gramicidin, however, appears to be more subtle and to some extent reversible.[21] For instance, staphylococci which have been "killed" by gramicidin and are unable to grow on meat infusion peptone mediums can be made to grow in the presence of certain tissue components.

Heilman and Herrell [33] showed by the use of tissue culture medium that purified gramicidin and a concentrated preparation of penicillin are of the same order of activity against strains of gram-positive cocci. By the same methods they observed that both substances, besides being bacteriostatic, may be bactericidal under certain conditions. Neither of these substances enhances or inhibits the bactericidal activity of the other. Ferraro [26] observed no advantages in combining sulfathiazole with gramicidin or tyrocidin, since the optimum bactericidal effect was obtained with gramicidin alone.

It is interesting to note that penicillin and gramicidin can be put in a class with the sulfonamide compounds in that they are different from all other antiseptics, which are merely protoplasmic poisons. All three of these substances are primarily bacteriostatic, rather than bactericidal, in their action. Since they do not destroy the respiration of bacteria, one may assume that their bacteriostatic action depends not on the destruction of the entire metabolism of the micro-organisms but on some subtle interference with certain individual biologic reactions.

From the clinical reports published thus far, penicillin appears to be the most potent chemotherapeutic agent known. Its remarkable features include its bacteriostatic action in an amazingly low concentration, its ability to diffuse into infected and dead tissues and its nontoxicity in therapeutic doses. The United States Army [34] has recognized these unusual properties, for the results of its local application in recent preliminary clinical trials have been so encouraging that studies are now being extended to ten general army hospitals. The military requirements will no doubt utilize all available supplies of penicillin; because of this fact, its use should be restricted to infections with local thrombus formation, more particularly to the conditions that are resistant to therapy with the sulfonamide compounds. Its future use in ophthalmology may be limited not only to severe infections of the conjunctiva and cornea but to intraocular infections.

By the present methods of production, it is obvious that penicillin and gramicidin cannot be produced on a scale similar to that of the sulfonamide compounds. However, when a more exact knowledge of their chemical structure, especially of the molecular groups to which they owe their biologic activity, is obtained, the synthetic chemist will have valuable clues for the production of new substances which, it is hoped, may be of greater practical value than either penicillin or gramicidin.

SUMMARY

In a review of the literature on penicillin and gramicidin presented here, their ocular uses, both experimental and clinical, are particularly stressed.

The use of penicillin in clinical ophthalmology has been promising to the limited extent to which it has been reported.

Gramicidin as such has not been reported on as an ocular chemotherapeutic agent, but when it has been used in the form of tyrothricin the results have been disappointing.

Department of Ophthalmology, Cook County Hospital.

32. Dubos, R. J.: The Effect of Specific Agents Extracted from Soil Microorganisms upon Experimental Bacterial Infections, Ann. Int. Med. **13**:2025-2037, 1940.

33. Heilman, D. H., and Herrell, W. E.: Mode of Action of Gramicidin, Proc. Soc. Exper. Biol. & Med. **47**:480-484, 1941; footnote 25.

34. Richards, A. N.: Penicillin, statement released by the Committee on Medical Research, J. A. M. A. **122**: 235-236 (May 22) 1943.

Correspondence

COMPARISON OF OCULAR IMAGERY

To the Editor:—I have read with great interest Dr. Lancaster's comments on my paper entitled "A Comparison of Ocular Imagery," published in the June 1943 issue of the ARCHIVES, and I wish to thank him for his statements and comments. However, he seems to be of the opinion that no instrument save the eikonometer is useful in measuring ocular imagery. As I stated in my original paper, I feel that in their present stage of development neither the eikonometer nor the comparator is adequate for measuring accurately a state of aniseikonia.

The "just noticeable difference" which Dr. Lancaster mentions is well recognized by all ophthalmologists and has been the subject of considerable investigation by various students of the comparator, as well as the eikonometer.

It is unfortunate that the national emergency has interfered with investigation of these two instruments. I am unable at present to accept the eikonometer as the only instrument for comparison of imagery in the two eyes. Dr. Lancaster states that the data obtained by the comparator are of no value. I submit that they are of the greatest value in showing the defects of the instrument.

Efforts are now being expended to overcome the lack of sensitivity of the comparator. As with the eikonometer, work must be done to find a target which gives most sensitivity and yet is not so large that it causes great rotation of the eyeballs.

I am not advocating any one instrument. The fact that in the Army we use the eikonometer for our measurements should indicate our realization of its good points. The fact that we are interested in the development of the comparator should reveal the fact that we do not think the eikonometer a perfect instrument. Again I state, both instruments are in a developmental stage, an embryonic one so to say. It is conceivable that the eikonometer which is eventually used may well be one of revolutionary design.

CAPTAIN HOMER B. FIELD, Medical Corps, Army of the United States.

To the Editor:—I fear I did not make my point sufficiently clear, as I did not wish to be too outspoken. I am not by any means "of the opinion that no instrument save the eikonometer is useful in measuring" aniseikonia, or "ocular imagery," as Captain Field prefers to call it (a better device has long been in use at the Dartmouth Eye Institute), but I was attempting to show that the data given were unscientific. Imagine trying to measure 1 per cent with an instrument on which the subject could not detect 5 or 10 or (in some cases) even 20 per cent; think of expecting a patient to detect a difference of 1/50 inch (0.5 mm.) at 15 feet (457 cm.) and try to conceive of an ophthalmologist's advocating an instrument for measurement of heterophoria which showed systematically a tendency to convergence on his looking into the machine, as the readings for all esophorias were too large and those for most exophorias were too small, to say nothing of the presence of right hyperphoria in 18 of 25 subjects with average vision.

WALTER B. LANCASTER, M.D., Boston.

520 Commonwealth Avenue.

OCULAR OCCLUDERS

To the Editor:—The advantageous use of monocular occlusion for long periods for both diagnostic and therapeutic purposes has been established. In a recent report from the Dartmouth Eye Institute the remarkable benefits to be derived from such prolonged monocular occlusion are detailed. In a number of cases permanent monocular occlusion was found to be the only way to relieve intolerable ocular distress. In over 50 per cent of a series of 80 cases relief was obtained during occlusion and with the prescription obtained after the period of occlusion. The great problem is how to provide an occluder which will not be disfiguring. Monocular occlusion would certainly be much more widely practiced if it were possible to do so with an inconspicuous occluder. An opaque contact lens is probably best, but its use is not always feasible.

The real purpose of occlusion, it seems to me, is to prevent binocular fixation of the object of attention. All the difficulties incident to binocular vision are due to the desire and associated effort to fuse or unify the two macular images. When such fusion has been made impossible or undesirable, the difficulties incident to bimacular vision vanish. The displacement and distortion tests employed in the measurements employ this phoria principle. One eye fixates the target, while the other eye, whether or not it ignores the distorted or displaced image, makes no effort to fuse it with the macular image of the fixing eye. In a case of manifest strabismus, for the same reason, there are no visual discomforts which can be attributed to the use of both eyes because there is no bimacular vision. But the deviated eye does not ignore everything in its field of vision.

By employment of the principles of the phoria tests one can eliminate bimacular vision by merely displacing and/or distorting the image in one eye

to such an extent that bimacular vision is neither desirable nor possible. A clear lens made up on this principle would look much like any other lens in an ordinary pair of spectacles. A similar lens which has been used to avoid annoying diplopia after cataract extraction was recently described by Mr. Edward J. Boyes in *Guildcraft* for April-May 1943. Such a lens also gives the patient some field vision on the side of the "occluded" eye.

The proper selection of the best lens to be used will tax the ingenuity of both the physician and the optician. The "occluding" lens should be as light as possible and match as nearly as possible the lens worn by the other eye. It may be a sphere, a cylinder or a compound plus or minus sphere and cylinder, all combined with a prism of the least strength necessary to eliminate fusion and annoying diplopia. Probably a strong cross cylinder ground as such or as a spherocylinder or as a toric lens on one or both sides can be made to match most ordinary lenses and to produce sufficient distortion and displacement of the unwanted image. If the plus cylinder is placed at axis 180, it may be possible to introduce sufficient decentration for a prism base up or base down.

Since the critical area of central vision employs only a small section of the lens, probably at most a disk about 20 mm. in diameter, the "occluding" lens may also be made lenticular. The central area would carry the distorting and displacing power, and the rest of the lens would allow for peripheral field vision. Finally, when an actual occluding lens must be used, it is sufficient to frost the central area of the lens. I believe, however, that a judicious combination of sphere and/or cylinder and/or prism in a fully clear lens will always accomplish the purpose of monocular "occlusion" with a minimum of annoyance to the patient.

JOSEPH I. PASCAL, M.D., New York.

37 West Ninety-Seventh Street.

CORNEAL TRANSPLANTATION

To the Editor:—In the January 1944 issue of the ARCHIVES, page 118, Dr. Olga Sitchevska reviewed a book entitled "Corneal Transplantation with Fresh, Preserved and Fixed Material," by O. I. Shershewskaya.

Her comment that my only operation using fixed material was unsuccessful apparently derived from the Russian original. I should appreciate having this error corrected in the ARCHIVES.

The case in question was briefly described in Albrecht von Graefe's *Archiv für Ophthalmologie* **107:** 454, 1922. The last paragraph on this page states that the transplantation of a disk previously fixed in formaldehyde had been performed for tectonic, not for optic, purposes: The intention was to cover a fistula in a case of total corneal leukoma, and the transplant took in spite of having been preserved in formaldehyde for eight weeks prior to the operation. Despite the expectedly poor visual result, the outcome was entirely satisfactory in that the transplant finally closed a fistula which had not responded to other treatments.

K. W. ASCHER, M.D., Cincinnati.

2508 Auburn Avenue.

Obituaries

PROF. ALFRED VOGT

1879-1943

For those ophthalmologists who were not personally acquainted with Dr. Vogt, the news of his death on Dec. 10, 1943 may have been a surprise. Until recently they knew him as an active and productive scientist and writer. His close friends, however, were more amazed that he was able to carry on as long as he did. In 1939, for his sixtieth birthday, his friends and former assistants presented him with a "Festschrift" [1] containing over ninety papers, written in several languages and by people from all over the world. As it was already known that Dr. Vogt suffered from a severe vascular disease, his friends were all happy that this demonstration of appreciation of the master's work came in time for him to enjoy it. For the last four years only an almost superhuman energy, combined with complete devotion to his task, enabled him to continue his work.

In evaluating an outstanding personality like Alfred Vogt's, one always feels inclined to comparisons with figures of the past. Vogt's work and career indeed remind one in many ways of those searchers and fighters of the early days of modern medicine. Like Robert Koch, for instance, Vogt made some of his fundamental discoveries far away from the country's institutes designed and equipped for research. While practicing ophthalmology in a provincial town, his imaginative mind led him to fundamental studies and experiments. His academic career likewise was unusual. He did not spend decades at some institution, repeating his master's voice, in order to slip finally into some position, as is done usually. He was called to head an ophthalmic institute in a university directly out of his practical position, without having climbed the academic ladder step by step.

Alfred Vogt was born in 1879 on a farm near Aarau, Switzerland, his father being a school teacher and farmer at the same time. His inclination for the natural sciences became evident when, still a boy, he assembled an unusually complete collection of butterflies. He also was interested in history and was particularly impressed by the struggle for freedom of the old Swiss. Indeed, he continued to love his country and its democratic institutions all his life. After graduation from the University of Basel he got his ophthalmologic training mainly at the Ophthalmic Institute of the University of Basel, at this time directed by Mellinger. He then established himself as specialist in ophthalmology at Aarau and became head of the department of ophthalmology in the cantonal hospital of that town. Having been one of the first to recognize the importance of Gullstrand's ingenious invention of the slit lamp for study of the morphology and pathology of the eye, he improved this instrument and put it to work with all the thoroughness, endurance and imagination characteristic of him. It was then, too, that Vogt discovered the surprising result of using red-free light for ophthalmoscopy. He could prove, for instance, that the macula lutea in the living eye was really yellow, bringing to a conclusion an age-old controversy. His discoveries, however, were passionately questioned by the recognized experts in the respective fields of ophthalmology. C. von Hess stubbornly stuck to his description of the morphology and the pathogenesis of the senile cataract, which was in disagreement with Vogt's observations. But although von Hess, who was one of my venerated teachers, was then a leading ophthalmologist, he proved to be wrong, having become the victim of an experimental setup which was much inferior to Vogt's slit lamp. Gullstrand passionately denied the presence of any color in the macula lutea, defending his own theory of a phenomenon of contrast. But he, too, proved to be wrong, as every one using Vogt's new light could really see the yellow color of the macula. These victories over two of the most prominent representatives of contemporary ophthalmology made Vogt appear in the spotlight almost overnight.

In 1918 he was appointed professor of ophthalmology and director of the Ophthalmic Institute of the University of Basel. In 1923 he received and accepted a call to direct the University Ophthalmic Institute of Zurich, which was a great honor in view of the high tradition of this institute, men like Horner and Haab having been connected with it. As professor of ophthalmology, Vogt soon became one of the most prominent members of the faculty. He

1. The "Festschrift" also contains a complete chronologic list of Professor Vogt's contributions.

remained in this position until his resignation, a few months before his death.

The work accomplished by Vogt during the twenty years in Zurich is equally impressive in volume and in quality. Although he concentrated on some special subjects, his publications cover almost the whole field of theoretic and practical ophthalmology. It will be possible to mention but a few of his major contributions here.

Vogt's "Atlas of the Slitlamp Microscopy of the Living Eye" (Berlin, J. Springer, 1921) is probably his best known work in America. Before I left Switzerland, in 1941, for a study trip to this country, Vogt seemed for a while to

ALFRED VOGT, M.D.
1879-1943
(Festschrift für Herrn Professor Dr. A. Vogt, Klin. Monatsbl. f. Augenh., October-November 1939, vol. 103.)

be inclined to join me, as many invitations had already reached him. Finally, however, he decided to stay in order to complete the third volume of his "Atlas." He must have felt that the days of work would come to an end and that he could not afford to waste any time. After the volume had been printed and published in Switzerland, he sent me one of the first copies and asked me to make arrangements for an English edition. There is hope that this atlas, equally outstanding for its text and for the accuracy of the illustrations, will be made available to the English-speaking world in the near future. As a matter of fact, many American ophthalmologists received their first training with the slit lamp from Vogt, while attending his courses in Zurich.

In connection with exhaustive clinical and pathologic studies of the so-called glass blower cataract, Vogt proved by numerous ingenious experiments that infra-red radiation may cause cataract in rabbits, as he thought, partly because of a special affinity of the lens fibers for this category of radiation and partly because of the heat produced when the rays strike the pigmented iris and the ciliary body. Thus he was able to give a satisfactory explanation of this industrial disease.

Having been one of the first to accept Gonin's theory and technic of the surgical treatment of the detachment of the retina, he tried it out on a large number of patients, improving the technic and summarizing his experience in the book entitled "Die operative Therapie und die Pathogenese der Netzhautablosung" (Stuttgart, Germany, Ferdinand Enke, 1936). The study of this book is of tremendous value for any one engaging in the surgical treatment of the detached retina. Out of the experience with perforating diathermy in the operation of the retinal detachment Vogt developed what he called the "cyclodiathermy puncture" of the ciliary region as a measure in certain complicated cases of glaucoma. He also devised a special instrument for this operation.

Important work was done by Vogt in the field of heredity. He produced countless cases and pedigrees of various diseases now recognized to be of hereditary nature. Most of this work, of course, concerned diseases of the eye, but having at his command an extensive knowledge of general natural science, Vogt often engaged in more general problems of human pathology, dental caries being one of them. The most original contribution in the field of heredity is the study of senile changes in identical twins, which he carried out during the last few years. It appeared that the eyes of identical twins are alike to a large extent, including even minor details, and special emphasis was given the fact that senile cataract not only appeared at the same period of life but was of the same morphologic type in each twin, although they had lived in entirely different environs. These observations have been published in part by Vogt and his assistants in the *Archiv der Julius Klaus Stiftung für Vererbungsforschung, Sozialanthropologie und Rassenhygiene,* in 1939, and now constitute one of the most interesting parts of the third volume of the "Atlas," published in 1942.

A great writer himself, Vogt belonged to the editorial staff of a number of ophthalmologic periodicals, the *Klinische Monatsblätter für Augenheilkunde, Albrecht von Graefes Archiv für Ophthalmologie* and *Zeitschrift für Augenheilkunde* being probably the ones which profited most from his contributions. He also was a member of a number of scientific societies in various countries, but he was most devoted to the Swiss ophthalmologic society, of which he was one of the founders and a past president. Many of his discoveries have been reported first at its annual meetings. He also made an endowment to this society to induce the award of a prize for the writer of the best paper each year. This endowment was made in memory of his only son, who died tragically in an avalanche accident in the Swiss Alps. Vogt's keen interest in the Swiss ophthalmologic society naturally had a tremendously stimulating effect, which undoubtedly accounts in great part for the unusually high standard of the contributions made by this numerically small group.

Vogt's work and personality earned highest public appreciation on several occasions. A call from the University of Munich, second only to the University of Berlin, undoubtedly was a great honor. But Vogt could not make up his mind to accept it, and I know he never regretted having remained in his independent position in Switzerland. He was awarded the Donders medal and recently, in 1942, the golden Gullstrand medal, which represent the highest distinction any ophthalmologist can receive.

Besides his work as a scientist, writer and teacher, Vogt was engaged in an enormous private practice, and it is hardly exaggerated to say that he had become the most famous ophthalmologist of the European continent. Many prominent people were among his patients, although not all the sensational stories reported by the newspapers were true. Vogt himself, more amused than embarrassed, explained to me how some of these stories originated from simple confusion. There are always legends being built up around a famous name. But all this fame did not prevent Dr. Vogt from giving his full attention and all of his precious time to a poor patient of the ward if his personal intervention was indicated, as I myself witnessed in many instances.

It is obvious that so much work could not be done without sacrifices in private life. Although he was a devoted husband and father, Vogt's family, his wife and two lovely daughters, who remained after his only son's tragic death, were not given the privilege of enjoying him as much as they desired and deserved. I should even say that not all that work for the benefit of humanity would have been possible without the unselfish attitude of Mrs. Vogt, who was sincerely interested in her husband's work and anxious to manage so that his social life caused the least possible interference. There was, also, little time left for hobbies, an occasional fishing trip and the collection of paintings being those Vogt enjoyed most.

Many people thought Vogt was short, and even rude, at times. It is true that he did not like many words when it was, in his opinion, simply a matter of stating the facts. He was frank and would not hesitate to say exactly what he thought to patients, to colleagues or to anybody. But he was not unkind, and he certainly was sincere. When he called some one his friend, he meant it and was ready to stand by at any time. Those who had the privilege of knowing more intimately this unusually strong and interesting personality not only enjoyed his always spirited conversation but were often touched when they recognized that, however hard the shell, it sheltered a loving and sympathetic heart.

Alfred Vogt will always have a place among the great physicians and scientists of all time. To ophthalmology few have contributed as much as he did. He was equally as capable of conceiving a new idea as of assembling minute details. This makes his work unusually complete. An extremely hard worker and a strong and upright character, he was the real personification of that rough mountain country from which he originated.

FREDERICK W. STOCKER.

Abstracts from Current Literature

EDITED BY DR. WILLIAM ZENTMAYER

Aqueous Humor

DIFFERENCES OF TENSION IN THE CHAMBERS OF THE EYE: REPORT OF A CASE. A. LUZSA, Klin. Monatsbl. f. Augenh. **106:** 422 (April) 1941.

The author discusses the unsolved problem of the production, circulation and drainage of aqueous humor. The theories of Leber and Hamburger are given special consideration. Luzsa had an opportunity to study this problem in the case of a boy aged 7 both of whose eyes were smaller than normal, the corneal diameters being 9 mm. in both principal meridians. Persistent hyaloid membranes were present in both eyes, the fundi of which were otherwise normal. The right eye showed a congenital, incomplete coloboma in the lower portion of the iris, located slightly nasal to the median line. The pigment layer and the reaction of the pupil were normal. Both eyes were hyperopic, and the left eye manifested amblyopia and an internal strabismus. The left eye presented a dark brown, bullous prominence in the lower portion of the iris, slightly nasal to the median line and about 3 mm. in diameter.

The bulla changed its shape and size, extending when the patient looked at a distance and collapsing on accommodation for near vision. The bulla collapsed with pressure on any portion of the cornea, extending again on release of the pressure. This procedure could be repeated in swift succession. The bulla collapsed occasionally when the child batted his lids. It emptied slowly when he was asked to look gradually at a distance and became distended when he looked at a distance of 75 cm.

Luzsa thinks that the bulla was caused by a small area of hypoplasia in the iris, followed by protrusion of the pigment layer. Its extension was due to afflux of aqueous humor into the posterior chamber. This process is indicative of a difference in pressure between the anterior and the posterior chamber, the pressure being alternately higher in one and in the other. The difference occurred simultaneously with the change in the form of the lens and its position during accommodation. Contraction and dilatation of the pupil had no influence on the difference of pressure in the chambers.

No information regarding the circulation of the aqueous humor could be gained from this case.

K. L. STOLL.

Congenital Anomalies

FIBROBLASTIC OVERGROWTH OF PERSISTENT TUNICA VASCULOSA LENTIS IN INFANTS BORN PREMATURELY. T. L. TERRY, Am. J. Ophth. **25:** 1409 (Dec.) 1942.

This is the third of a series of studies on the development and regression of the hyaloid artery and the tunica vasculosa lentis. The material used consisted in serial sections of eyes from more than 50 human fetuses, representing many stages of development. The eyes of fetal and newborn animals, including the cat, rat, pig and opossum, were also studied. The observations and conclusions are summarized.

W. S. REESE.

ARACHNODACTYLY (MARFAN'S SYNDROME) A. A. BARRON, North Carolina M. J. **3:** 353 (July) 1942.

Barron reports on a family, several members of which had arachnodactyly. The mother and 6 of her children showed the characteristic elongated bony structure. Four of the siblings had ectopia lentis. Of these 4, 1 had a left lateral curvature of the lumbar portion of the spine, while another had had two acute attacks of lymphocytic meningitis and chronic symptoms which seemed to indicate involvement of the central nervous system. There is no proof either that this simultaneous occurrence of meningeal and arachnodactylous symptoms was a coincidence or that the two chronic conditions were linked in close association. The article is illustrated.

W. ZENTMAYER.

Cornea and Sclera

SULFADIAZINE IONTOPHORESIS IN PYOCYANEUS INFECTION OF RABBIT CORNEA. L. VON SALLMANN, Am. J. Ophth. **25:** 1292 (Nov.) 1942.

In experiments on rabbits von Sallmann observed that iontophoretic administration of sulfonamide compounds achieved higher concentrations in the anterior segment of the eye than other clinical methods, sulfadiazine entering in greater amounts than the other sulfonamide drugs studied. Sodium sulfadiazine so used in a case of infection of the rabbit cornea with Bacillus pyocyaneus gave results superior to other local methods and to general treatment. These good results were enhanced by oral use of sulfadiazine. The most favorable treatment of keratitis of this type in rabbits was a combined method of iontophoretic administration of sodium

sulfadiazine and local and oral use of the powder. These observations were confirmed by the results of treatment of 2 patients suffering from corneal ulcers due to infection with B. pyocyaneus.

W. S. Reese.

A Case of Bowen's Disease of the Cornea. G. Wise, Am. J. Ophth. **26:** 167 (Feb.) 1943.

Wise discusses Bowen's disease from the clinical, pathologic and metastatic standpoints. He reports a case of the disease in an Italian aged 62, in whose right eye there were three distinct small, fleshy, pink masses, located at 3, 12 and 9 o'clock on the limbus. These were freshly movable and unattached to the limbus and were fed by dilated, somewhat tortuous, vessels. The cornea was covered with an opaque, uneven, thickened tissue, which connected with each lesion in the limbus. The mass was excised, and a diagnosis of intraepithelial epithelioma was made.

W. S. Reese.

The Treatment of Herpetic and Dendritic Ulcers. F. O. Schwartz, Am. J. Ophth. **26:** 394 (April) 1943.

Schwartz reports cases of herpetic and dendritic ulcers of the cornea. In all cases foci of infection were present in the sinuses, tonsils or teeth, and there was an undoubted relation between these foci and the corneal ulcers; all the corneal lesions resisted treatment and made no definite progress until these foci were removed. The author concludes that an unidentified virus, which may have its origin in the focus of infection, should be considered an etiologic factor in the production of herpetic and dendritic keratitis.

W. Zentmayer.

Fungous Diseases of the Cornea: Report of Cases. A. Fazakas, Klin. Monatsbl. f. Augenh. **106:** 56 (Jan.) 1941.

Fazakas noted various types of fungi in 25.65 per cent of healthy eyes and in 37.08 per cent of diseased eyes. He concludes that the cornea, the conjunctiva, the lacrimal apparatus and the palpebral margin in the region of the meibomian glands offer better nutrition to fungi in diseased than in normal conditions. He observed about two dozen forms of fungi, which retarded recovery, for instance, from trachomatous and eczematous pannus. The fungus changed the picture of the initial disease in some instances, as in a case of dentritic keratitis and in several cases of trachoma, inclusion blenorrhea and acute and chronic simple conjunctivitis. Most keratomycoses are produced by Aspergillus; the fungus produces ulcers, or nodules, occasionally appearing on different portions of the cornea. In 1 case of infection with Aspergillus flavus there were several recurrences with severe keratitis and iritis, followed by glaucoma. The decrease in intraocular tension after paracentesis of the anterior chamber was maintained only as long as the corneal wound remained open. The escaping aqueous failed to dislodge the fungus colonies in the anterior chamber. Final recovery was obtained by repeated paracenteses and flushing the anterior chamber with solution of iodides.

K. L. Stoll.

General Diseases

The Diagnosis of Ocular Syphilis. B. F. Payne, Am. J. Ophth. **26:** 266 (March) 1943.

Payne discusses the diagnosis of syphilis and emphasizes the importance of early detection of the disease. He cites other diseases with which the Wassermann and other serologic tests give positive reaction. He refers briefly to treatment, suggesting that here the ophthalmologist should play the role of an umpire and confine his attention to the eye.

W. S. Reese.

Arteritis of the Temporal Vessels Associated with Loss of Vision. R. H. Johnson, R. D. Harley and B. T. Horton, Am. J. Ophth. **26:** 147 (Feb.) 1943.

The authors report 3 cases of loss of vision due to retinal or retrobulbar vascular accidents associated with arteritis of the temporal vessels. The authors believe that the arteritis was more extensive than could be detected on careful physical examination. Microscopic examination of resected temporal vessels for the most part indicated a chronic inflammatory process. None of the patients has died.

W. S. Reese.

Ocular Findings in a Case of Periarteritis Nodosa. I. E. Gaynon and M. K. Asbury, Am. J. Ophth. **26:** 1072 (Oct.) 1943.

In a case of periarteritis nodosa autopsy revealed advanced generalized arteriosclerosis with terminal focal arteriolar sclerosis, focal syphilitic arteriolitis and focal periarteritis nodosa. In the choroid the predominating vascular lesion was arteriosclerosis with terminal necrosis. A few vessels in both the retina and the choroid showed inflammatory changes suggesting in some instances syphilitic arteriolitis and in others early periarteritis nodosa. Failing vision due to a pathologic condition of the retina typical of malignant hypertension was the first symptom.

W. Zentmayer.

Glaucoma

Evaluation of Glaucoma Operations. B. F. Payne, Am. J. Ophth. **25:** 1474 (Dec.) 1942.

From a study of 100 enucleated eyeballs, Payne reached the following conclusions:

"A satisfactory evaluation of operations for glaucoma would appear to be hopeless in the face

of the cases . . . described. From the findings it would seem that any type of surgical procedure must be doomed to failure. It should be remembered, however, that these specimens represent failures, and despite the fact that there is no satisfactory operation for glaucoma there is some hope in the choice of surgical procedure. In reviewing the material for this paper, which was collected over a period of 10 years, it was noted that most enucleations followed paracentesis, posterior sclerotomy, and iridectomy. The number of specimens submitted after iris-inclusion operations, corneosclerectomy, and trephining amounted to less than 15 per cent of the total. From the viewpoint of the pathologist it seems that some form of corneosclerectomy is the operation of choice." W. S. REESE.

THE EFFECT OF MYDRIATICS UPON THE INTRAOCULAR PRESSURE IN SO-CALLED PRIMARY WIDE-ANGLE GLAUCOMA. P. C. KRONFELD, H. I. MCGARRY and H. E. SMITH, Am. J. Ophth. **26:** 245 (March) 1943.

From their tests on human eyes, the authors conclude that the response to mydriatics of early so-called primary wide-angled glaucoma is as a rule less constant than the response to the drinking test of Marx and Schmidt and that the latter test is therefore of greater diagnostic value.

W. S. REESE.

Hygiene, Sociology, Education and History

THE STORY OF THE RED CROSS INSTITUTE FOR THE BLIND (1918-1925) IN RELATION TO THE PRESENT PROBLEM OF THE WAR BLINDED. A. C. WOODS, Am. J. Ophth. **26:** 1011 (Oct.) 1943.

The Red Cross Institute for the Blind, organized first as General Hospital no. 7, but generally known as the Evergreen School for the Blind, was the agency established during World War I for the training and rehabilitation of members of the armed forces who became blind. In Woods's personal files are the records of 325 cases, which represent the total number of men trained at this school from March 23, 1920 until the close of the school in June 1925.

A review of the 325 cases shows that, on the basis of the ocular lesion, they may be classified as follows: trauma, 106 cases; disease of the optic nerve 66 cases; hysterical amblyopia, 27 cases; atrophic choroiditis, 17 cases; retinitis pigmentosa, 14 cases; amblyopia due to systemic disease, 12 cases; errors of refraction, 14 cases; injuries due to war gas, 12 cases; cataract, 12 cases; uveitis with secondary cataract, 8 cases; superficial keratitis, 9 cases; interstitial keratitis, 8 cases; trachoma, 5 cases; amblyopia due to cortical injury, 4 cases; detachment of the retina, 4 cases; glaucoma, 3 cases; superficial retinitis, 2 cases, and keratoconus and nystagmus, 1 case each.

Woods analyzes each group. The latter part of the article is devoted to a thoughtful consideration of questions concerning the men blinded during the present war but does not lend itself to abstraction. W. ZENTMAYER.

A SUMMARY OF FINDINGS AT THE EYE EXAMINATION OF PREPARATORY-SCHOOL BOYS. A. E. SLOANE and J. R. GALLAGHER, Am. J. Ophth. **26:** 1076 (Oct.) 1943.

The authors provide the following summary:

"1. Findings in various parts of an eye examination of a group of 1,009 preparatory school boys are given.

"2. The data indicate the importance of adequate screening eye examinations as a part of any health program involving adolescents.

"3. The desirability of including tests of hypermetropia and heterophoria as well as of visual acuity in any screening examination is shown.

"4. Questions regarding blurred vision, red eyes, and headaches are best asked by a physician: the evaluation of such symptoms will not be helpful unless the history has been carefully taken.

"5. There are at present no valid reasons for omitting annual eye tests even among children of the more privileged economic group.

"6. The Snellen test is inadequate for the selection of all children in need of a careful eye examination.

"7. The recommendation, on the basis of screening tests, for a further careful examination is better made by a physician after a consideration of all of the findings than by lay persons relying on set quantitative measurements alone."

W. ZENTMAYER.

Injuries

EYE SURGERY IN WAR TIME. E. HARTMAN, Am. J. Ophth. **25:** 1448 (Dec.) 1942.

The paper is based principally on the author's personal experience and on Duverger and Velter's book, "Ophthalmologie de guerre." The various injuries resulting from war and their treatment are outlined. W. S. REESE.

CONCERNING LAGRANGE'S LAW OF INDIRECT OCULAR WAR INJURIES. P. S. SOUDAKOFF, Am. J. Ophth. **26:** 293 (March) 1943.

From a study of reported cases, Soudakoff concludes as follows:

"Analysis of the cases of indirect war injuries to the eye communicated by various authors discloses the existence of a distinct relationship between ocular lesions and injuries of the facial bones. The presence of the fracture of the facial bones as well as the fracture of the anterior or posterior orbital wall predicts definite lesion of

the membranes of the eye, or injury to the optic nerve, according to the laws formulated by Lagrange.

"The observations of the indirect injuries of the eye during the present war will give ample opportunity for American ophthalmologists to verify the correctness of Lagrange's deduction and to modify his law according to new findings."

W. S. REESE.

NONSURGICAL ASPECT OF OCULAR INJURIES. F. C. CORDES, Am. J. Ophth. **26:** 1062 (Oct.) 1943.

The discussion of ocular injuries is based on knowledge gained during World War I, in civilian practice and from the reports from abroad based on experiences in Poland, Barcelona, Dunkirk, Coventry, London and the front lines.

Cordes stresses the following fundamental principles that should be kept in mind in the care of ocular injuries in war time.

"1. Penetrating wounds of the globe, iris prolapse, and lid injury require immediate surgical care if the proper facilities are available. If not, the wounds should be cleaned, a dressing applied, and the patient sent to a base where proper facilities are available. In the event of a lid injury a moist dressing is indicated. In cleaning up lid injuries débridement technique used in other wounds would be ruinous to the lids and conjunctiva where every millimeter of tissue must be saved.

"2. As to foreign bodies of the cornea and globe, experience indicates that it is best not to interfere until the patient has recovered from shock and until the foreign bodies can be removed under favorable circumstances. It is also well to remember that minute foreign bodies of the cornea are often spontaneously extruded during the first 24 hours.

"3. In cases of thermal burns of the cornea the routine, continued use of anesthetics is to be avoided, as any of the anesthetics interfere with the healing of the cornea. In general it has been found that unless there is some definite indication for the local use of drugs, the eyes recover from injury more rapidly if these are not employed.

"4. War-gas burns of the eyes or exposure to war gas requires immediate attention. The most effective universal treatment, irrespective of the type of gas, or in the event of a mixture of gases, would appear to be that based on an alkaline hydrolysis by the use of approximately 2 per cent sodium bicarbonate. This can be simply made by dissolving a teaspoonful of baking soda in a glass of water."

W. ZENTMAYER.

Lids

MODIFIED EWING OPERATION FOR CICATRICAL ENTROPION. J. E. SMITH and A. A. SINISCAL, Am. J. Ophth. **26:** 382 (April) 1943.

The authors have used a modified Ewing operation for cicatricial entropion in over 500 patients, with recurrence of the incurvation in only 0.5 to 1 per cent of the series. The method provides a wide range of application and can be effective either to the upper or to the lower lid.

The various steps of the operation are well illustrated.

W. ZENTMAYER.

A COMBINED PTOSIS OPERATION. O. H. ELLIS, Am. J. Ophth. **26:** 1048 (Oct.) 1943.

A combined operation for the correction of ptosis is described. The method utilizes a strip of the tendon of the superior rectus muscle, the transplant being allowed to heal in the desired position in the upper lid without tension, as a result of the placement of Pagenstecher sutures. The procedure is based on firm surgical principles and is indicated in cases in which there is good action of the superior rectus muscle. The steps of the operation are clearly illustrated in the article.

W. ZENTMAYER.

Society Transactions

NEW YORK ACADEMY OF MEDICINE, SECTION OF OPHTHALMOLOGY

FRANK C. KEIL, M.D., *Chairman*

WILLIS S. KNIGHTON, M.D., *Secretary*

Dec. 20, 1943

Transscleral Removal of Intraocular Foreign Body with Aid of the Berman Locator. DR. HENRY MINSKY.

This article will be published in a later issue of the ARCHIVES.

Foreign Body in the Lens with Formation of Cataract: Method of Extraction. DR. A. RUSSELL SHERMAN, Newark, N. J.

A man aged 31 was struck in the right eye with a piece of steel. Examination of the eye six weeks later revealed a perforating scar in the cornea, a hole in the underlying iris and a posterior subcapsular opacity in the lens. A foreign body lay in the anterior part of the lens. Vision was 20/40.

Within two months the lens swelled and reduced vision to perception of hand movements; later iron pigment surrounded the foreign body, but there was no siderosis.

Operation was performed about eight months after the accident. A keratome was introduced through the upper part of the cornea and was carried into the lens. The foreign body was removed with a hand magnet and the cortex of the lens washed out. Final corrected vision was 20/20.

This case is reported to illustrate a satisfactory method of treating a patient with a magnetic foreign body in the lens. Removal of the foreign body before a cataract has formed may produce a cataract and require an extraction at a time when the eye is not in the most favorable condition for operation. It is not advisable to attempt to draw the foreign body through the lens capsule, since the resistance to the passage of the body is considerable and the lens may be dislocated. It is obvious that the eye must be observed at intervals of a few weeks for evidence of siderosis. The probability of uveitis is not great.

Injury to the Ciliary Body Without Iridocyclitis. DR. A. RUSSELL SHERMAN, Newark, N. J.

A man aged 48 was struck in the right eye by a metal pin from a drill press. A roentgenogram did not reveal any foreign body. The wound in the eye extended from the limbus 2 mm. into the cornea and 5 mm. into the sclera, through which the iris, ciliary body and vitreous protruded. This prolapsed tissue was excised; the scleral wound was closed with a suture near the limbus, and the conjunctiva was sutured. Both eyes were covered. Large doses of sulfadiazine were given by mouth, and the eye was not dressed for four days, when there was only slight redness. Eight days after the injury the vitreous was clear and the fundus was seen clearly. The patient was discharged from the hospital.

Three days later there was a large hemorrhage in the vitreous, and no fundus reflex was obtained. Two months later a slight fundus reflex, was visible, and the eye gradually lost its redness and sense of irritation.

This case, in which the ciliary body suffered not only an incision but a partial excision, is reported to emphasize that injury to the ciliary body is not synonymous with loss of the eye, much less with sympathetic ophthalmitis. One need not fear sympathetic inflammation during the first two or three weeks, or for a much longer period, if the fellow eye is kept under frequent observation with a slit lamp. Experience indicates that an eye which during the first few weeks after injury shows progressive lessening of the inflammatory reaction retains its light projection and does not become soft, does not constitute a danger and can usually be preserved, often with useful vision.

Detachment of the Retina Resulting from Traction Exerted by an Intraocular Foreign Body. DR. A. RUSSELL SHERMAN, Newark, N. J.

A man aged 28 was struck in the right eye by a particle from a hammer. There were a small wound of the central part of the lower lid margin and a wound of the conjunctiva just below the limbus. Blood was observed in the vitreous inferiorly, and a detachment of the retina above supported a foreign body, as in a hammock. Vision was 1/200, and there was contraction of the visual field, corresponding to the detachment and to the blood in the vitreous.

The tendon of the superior rectus muscle was severed and reflected upward, together with the conjunctiva and Tenon's capsule. The foreign body, measuring 2 by 2 by 3 mm., was removed with a hand magnet through a scleral incision 3 mm. long, above the cornea and temporal to the muscle. Electrocoagulation was applied through the exposed sclera with the Gradle electrode. A 2 mm. trephine opening was made in the sclera as far back as possible, and the choroid was perforated through this opening with a lacrimal punctum dilator.

During postoperative convalescence there was no evidence of reattachment and no fundus reflex was seen. The tension was too low to register on the tonometer. Although the eye had been white a month after the operation, it became red and painful two weeks later and was enucleated.

Apparently this foreign body, having perforated the globe below, passed upward through the vitreous, perforating the retina above. It then dropped downward dragging the retina with it. The detachment of the retina, resulting apparently from the pull of gravity on the foreign body, calls attention to the possibility of the production of such a detachment when a foreign body which has lodged between the retina and the sclera is removed by the anterior route. The operator is just as likely to produce a detachment of the retina by the latter procedure as by removal of the foreign body through a posterior incision.

Management of Industrial Injuries of the Eye. Dr. Elbert S. Sherman, Newark, N. J.

This paper will be published in full in a later issue of the Archives.

Suggested Revisions in the New York State Compensation Laws. Dr. Albert C. Snell Sr., Rochester, N. Y.

Management of Corneal Lacerations. Dr. Albert C. Snell Jr., Baltimore.

An analysis of 172 selected cases of perforating ocular injuries was made in an effort to determine the influence on the final outcome of the various possible complications. The following conclusions were reached:

1. With corneal lacerations less than 8 mm. long the length of the laceration in itself did not influence the chances for recovery.

2. Prolapse of the iris provided protection against intraocular infection.

3. The incidence of intraocular infection complicating perforating injury was 15 per cent and was not materially reduced by treatment with the sulfonamide compounds.

4. Minor intraocular hemorrhage had no effect on the prognosis, but severe intraocular hemorrhage was devastating.

5. Damage to the lens influenced the prognosis adversely, since it favored the development of intraocular infection and uveitis.

6. Results achieved in the repair of corneal lacerations with a conjunctival flap appeared to be only slightly less satisfactory than the use of direct corneal sutures.

Location of a Foreign Body in the Eye with a Contact Lens. Dr. Raymond L. Pfeiffer.

DISCUSSION

Dr. A. Russell Sherman, Newark, N. J.: I should like to report on an additional aid in the extraction of foreign bodies which have been localized by Dr. Pfeiffer's method. It is a ring, devised by Guist, to determine the external site of approach to a retinal tear in cases of detachment. The ring, which is marked at 10 degree intervals, rests on the limbus. A soft metal arm is held at the center of the ring by a thumb screw and can be revolved like the hand of a clock, so that it points along any desired meridian of the cornea, as indicated by the markings on the ring. Before the ring is applied, the arm is cut to the right length so that, as it extends beyond the limbus, its free end will lie over the intraocular foreign body. The ring can be left in position until the sclera is exposed, or it can be reapplied afterward, so that the sclera can be marked directly over the foreign body. I have used this ring in 4 cases in which the intraocular foreign body was localized by the contact lens method. In each case the foreign body was observed directly under the external mark on the sclera.

Book Reviews

An Introduction to Clinical Perimetry. By H. M. Traquair, M.D., F.R.C.S. (Edinburgh). Fourth edition, revised and enlarged. Price, $6.50. Pp. 350, with 245 illustrations and 3 colored plates. London: Henry Kimpton, 1942.

The third edition of "Traquair" was reviewed in the December 1938 issue of the ARCHIVES, page 1116. The present edition, which has 12 more pages of text and 18 more illustrations than its predecessor, is still the only monograph in English which deals adequately with the interpretation and evaluation of pathologic alterations of the visual fields as obtained by perimetry, and particularly by tangent screen scotometry.

In the first part of this volume 51 pages are devoted to the normal field of vision, perimetric and scotometric instruments and methods of examination. In the second part of the volume, after a comprehensive discussion of the pathologic field and an interpretation of the changes encountered, the author portrays, discusses and interprets the fields associated with glaucoma and lesions of the choroid, retina, optic nerve and chiasm in 152 pages. This portion of the volume should be of interest to all ophthalmologists. Twenty-nine pages are devoted to the suprachiasmal pathway, where most of the lesions and the resulting field defects are due to hemorrhage, thrombosis, tumor or injury. There are a short chapter on functional changes in the field of vision, an excellent appendix, a fairly complete bibliography, of 470 references, and author and subject indexes.

Traquair, whose work was developed from the principles of Bjerrum and Roenne, deserves acclaim because of his insistence on the use of weak stimuli (small visual angles) for detection of early changes in the visual fields. As he stated in a paper read before the American Ophthalmological Society (*Tr. Am. Ophth. Soc.* **37:** 158, 1939), "A method which does not include the use of a visual angle of 2 minutes or less . . . cannot be regarded as adequate any more than a test card would be regarded as adequate which had no lines below 6/12." His apparatus for tangent screen scotometry is simple, inexpensive and effective. It consists of a tangent screen, which is used at a distance of 2 meters from the patient, a set of white and colored test objects from 1 to 60 mm. in diameter and 7 foot-candles of illumination. As Arnold Knapp has said: "It is not the elaboration of apparatus that is important but the understanding of the one who takes the field." One becomes increasingly aware of this because Traquair interprets and evaluates his fields in terms of the anatomic, physiologic and pathologic characteristics of that portion of the visuosensory system in which the lesion occurs which produces the pathologic field.

During the past twelve years I have had the opportunity of mapping tangent screen fields for almost every condition described by Traquair and have obtained fields of essentially the same types as he did. I agree entirely with his statements that relative yellow-blue blindness develops early in conditions affecting the outer layers of the retina and that "baring of the blindspot" is one of the earliest changes in the fields associated with glaucoma. Like him, I have been unable to find the so-called Seidel scotoma in cases of early glaucoma.

This is a book by a clinician for clinicians. Every resident in ophthalmology should be as conversant with its principles as he is with various surgical technics. Finally, it is indispensable for the ophthalmologist who believes that the examination of the fields, when indicated, is the most important part of the ophthalmologic work-up, and not something to be delegated to his office nurse or secretary.

WALTER F. DUGGAN.

Strabismus: Its Etiology and Treatment. By Dr. Oscar Wilkinson and Dr. Richard W. Wilkinson. Second Edition. Price, $4. Pp. 369, with 71 illustrations. Boston: Meador Publishing Company, 1943.

The first edition of this book was published in 1927. For those not familiar with the earlier edition, it should be said that it was written largely in digest form and was composed chiefly of quotations from other authors. This plan has been preserved in the present edition, and while the book contains a great deal of useful and interesting material, its disconnected form makes it difficult and unsatisfactory reading for the beginner. One of the outstanding features of the original volume was the review of the history of strabismus. It is with regret that one finds that many of the historical quotations have been cut and several interesting illustrations omitted. The same is true of the chapter on anatomy, in which the illustrations have been reduced to the point of inadequacy.

On the other hand, there are some important additions to the book. Under "Etiology," the section on heterophoria has been rewritten, with incorporation of the ideas of Duane. The operative treatment of paralytic strabismus has been enlarged, in keeping with approved present day teaching. Methods of diagnosis of anomalous retinal correspondence have been added; however, the authors seem to favor the expression "nonretinal correspondence," for which this re-

viewer can find little justification, as it will surely add to the general confusion.

The section on "Orthoptics" has been completely rewritten and enlarged, as it should be, to include the vast amount of work that has been done in this department in recent years. This section of the book is excellent, particularly in its discussion of occlusion and the use of the major amblyoscope.

The willingness of the authors to operate on a child at an early age, tempered with the proper caution, is most commendable. Their detailed, unbiased presentation of the chief operative procedures will be of interest to the experienced surgeon but will probably prove bewildering to the beginner. On the other hand, they give a definite answer to the question asked by every student of muscle surgery: "What and how much shall I do for a given deviation?" No doubt, the table giving exact operative procedures for different deviations is of value, in their hands, but it must be used with great caution by other surgeons. The authors have described several operations of their own that are worthy of careful study. Their use of a scale to measure the pull of an overactive muscle sounds like the answer to a long-felt want.

One finishes this book wishing that the authors had given more space to their own opinions and less to those of other workers.

MAYNARD WHEELER.

Blood Transfusion in Ophthalmology. Collective papers from the Ophthalmic Clinic of the Tashkent Medical Institute. Price, 3 rubles. Pp. 56. Tashkent, Uzbek Soviet Socialist Republic: State Publishers, 1941.

This book contains nine articles from the ophthalmic clinic of the Tashkent Medical Institute on the value of blood transfusions in the treatment of ophthalmic disease. Prof. P. F. Arkhangelsky and his associates have used blood transfusions since 1935. They employ mostly preserved blood (from one to sixteen days), in small quantities (from 75 to 250 cc.), with an interval of about ten days between transfusions. They regard the action of the blood as nonspecific, possibly accelerating the metabolism of the tissues and activating the reticuloendothelial system.

Blood transfusions were given in treatment of various diseases of the eyes, but the most striking results were obtained in cases of opacities of the vitreous, regardless of the cause and the next best in cases of hemorrhages in the retina and of soft lenticular matter in the anterior chamber after extracapsular extraction of the lens. Favorable results were also observed in cases of trachomatous pannus and keratitis associated with herpes zoster from the use of subconjunctival injections of blood (from 0.5 to 1.5 cc.). One of the authors (Meschersky) reported that 2 patients with chronic glaucoma responded well to blood transfusions, as the tension was lowered and the visual acuity and visual fields were increased. A few patients with blepharitis who did not respond to any type of therapy improved considerably with blood transfusion therapy. In some cases corneal transplants which had become opaque cleared up after the transfusion of blood. Transfusions, however, are not considered to be a panacea for all ills, and the authors state that the measure should be resorted to only when all others fail. Blood transfusion may also be employed as a prophylactic measure before intraocular operations. A plea is made for further study of the therapeutic action of the blood in pathologic conditions of the eye.

OLGA SITCHEVSKA.

Directory of Ophthalmologic Societies *

INTERNATIONAL

International Association for Prevention of Blindness

President: Dr. P. Bailliart, 66 Boulevard Saint-Michel, Paris, 6e, France.
Secretary-General: Prof. M. Van Duyse, Université de Gand, Gand, Prov. Ostflandern, Belgium.
All correspondence should be addressed to the Secretariat, 66 Boulevard Saint-Michel, Paris, 6e, France.

International Ophthalmologic Congress

President: Prof. Nordenson, Serafimerlasarettet, Stockholm, Sweden.
Secretary: Dr. Ehlers, Jerbanenegade 41, Copenhagen, Denmark.

International Organization Against Trachoma

President: Dr. A. F. MacCallan, 17 Horseferry Rd., London, England.

Pan-American Congress of Ophthalmology

President: Dr. Harry S. Gradle, 58 E. Washington St., Chicago.
Executive Secretaries: Dr. Conrad Berens, 35 E. 70th St., New York. Dr. M. E. Alvaro, 1511 Rua Consolacão, São Paulo, Brazil.

FOREIGN

All-India Ophthalmological Society

President: Dr. B. K. Narayan Rao, Minto Ophthalmic Hospital, Bangalore.
Secretary: Dr. G. Zachariah, Flitcham, Marshall's Rd., Madras.

British Medical Association, Section on Ophthalmology

President: Dr. W. Clark Souter, 9 Albyn Pl., Aberdeen, Scotland.
Secretary: Dr. Frederick Ridley, 12 Wimpole St., London, W. 1.

Chengtu Ophthalmological Society

President: Dr. Eugene Chan.
Secretary: Dr. K. S. Sun.
Place: Eye, Ear, Nose and Throat Hospital, Chengtu.

Chinese Ophthalmology Society

Presdient: Dr. C. H. Chou, 363 Avenue Haig, Shanghai.
Secretary: Dr. F. S. Tsang, 221 Foochow Rd., Shanghai.

Chinese Ophthalmological Society of Peiping

President: Dr. H. T. Pi, Peiping Union Medical College, Peiping.
Secretary: Dr. C. K. Lin, 180 Hsi-Lo-yen Chienmeng, Peiping.
Place: Peiping Union Medical College, Peiping. Time: Last Friday of each month.

German Ophthalmological Society

President: Prof. W. Lohlein, Berlin.
Secretary: Prof. E. Engelking, Heidelberg.

Hungarian Ophthalmological Society

President: Prof. I. Imre, Budapest.
Assistant Secretary: Dr. Stephen de Grósz, University Eye Hospital, Máriautca 39, Budapest.
All correspondence should be addressed to the Assistant Secretary.

Midland Ophthalmological Society

President: Dr. W. Niccol, 4 College Green, Gloucester, England.
Secretary: Mr. T. Harrison Butler, 61 Newhall St., Birmingham 3, England.
Place: Birmingham and Midland Eye Hospital.

North of England Ophthalmological Society

President: Dr. A. MacRae, 6 Jesmond Rd., Newcastle-upon-Tyne, England.
Secretary: Dr. Percival J. Hay, 350 Glossop Rd., Sheffield 10, England.
Place: Manchester, Bradford, Leeds, Newcastle-upon-Tyne, Liverpool and Sheffield, in rotation. Time: October to April.

Ophthalmological Society of Australia

President: Dr. A. James Flynn, 135 Macquarie St., Sydney.
Secretary: Dr. D. Williams, 193 Macquarie St., Sydney.

Ophthalmological Society of Egypt

President: Prof. Dr. Mohammed Mahfouz Bey, Government Hospital, Alexandria.
Secretary: Dr. Mohammed Khalil, 4 Baehler St., Cairo.
All correspondence should be addressed to the secretary, Dr. Mohammed Khalil.

Ophthalmological Society of the United Kingdom

President: Mr. T. Harrison Butler, 61 Newhall St., Birmingham 3, England.
Secretary: Mr. L. H. Savin, 7 Queen St., London, W. 1, England.

Ophthalmology Society of Bombay

President: Dr. D. D. Sathaye, 127 Girgaum Rd., Bombay 4, India.
Secretary: Dr. H. D. Dastur, Dadar, Bombay 14, India.
Place: H. B. A. Free Ophthalmic Hospital, Parel, Bombay 12. Time: First Friday of every month.

Oxford Ophthalmological Congress

Master: Mr. P. G. Doyne, 60 Queen Anne St., London, W. 1, England.
Secretary-Treasurer: Dr. F. A. Anderson, 12 St. John's Hill, Shrewsbury, England.
Place: Oxford, England. Time: July 8-9, 1943.

Palestine Ophthalmological Society

President: Dr. Arieh Feigenbaum, Abyssinian St. 15, Jerusalem.
Secretary: Dr. E. Sinai, Tel Aviv.

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President: Dr. W. Kapuściński, 2 Waly Batorego, Poznań.
Secretary: Dr. J. Sobański, Lindley'a 4, Warsaw.
Place: Lindley'a 4, Warsaw.

* Secretaries of societies are requested to furnish the information necessary to make this list complete and keep it up to date.

ROYAL SOCIETY OF MEDICINE, SECTION OF OPHTHALMOLOGY

President: Col. F. A. Juler, 96 Harley St., London, W. 1, England.
Secretary: Dr. Harold Ridley, 60 Queen Anne St., London, W. 1, England.

SÃO PAULO SOCIETY OF OPHTHALMOLOGY

President: Dr. W. Belfort Mattos, Caixa Postal, 4086, São Paulo, Brazil.
Secretary: Dr. Silvio de Almeida Toledo, Enfermaria Santa Luzia, Santa Casa de Misericordia, Cesario Motta, St. 112, São Paulo, Brazil.

SOCIEDAD ARGENTINA DE OFTALMOLOGIA

Chairman: Dr. Jorge Malbrán, Buenos Aires.
Secretary: Dr. Benito Just Tiscornia, Santa Fe 1171, Buenos Aires.

SOCIEDAD OFTALMOLOGIA DEL LITORAL, ROSARIO (ARGENTINA)

President: Prof. Dr. Carlos Weskamp, Laprida 1159, Rosario.
Secretary: Dr. Juan M. Vila Ortiz, Córdoba 1433, Rosario.
Place: Rosario. Time: Last Saturday of every month, April to November, inclusive. All correspondence should be addressed to the President.

SOCIEDADE DE OPHTHALMOLOGIA E OTO-RHINO-LARYNGOLOGIA DA BAHIA

President: Dr. Theonilo Amorim, Barra Avenida, Bahia, Brazil.
Secretary: Dr. Adroaldo de Alencar, Brazil.
All correspondence should be addressed to the President.

SOCIETÀ OFTALMOLOGICA ITALIANA

President: Prof. Dott. Giuseppe Ovio, Ophthalmological Clinic, University of Rome, Rome.
Secretary: Prof. Dott. Epimaco Leonardi, Via del Gianicolo, 1, Rome.

SOCIÉTÉ FRANÇAISE D'OPHTALMOLOGIE

Secretary: Dr. René Onfray, 6 Avenue de la Motte Picquet, Paris, 7e.

SOCIETY OF SWEDISH OPHTHALMOLOGISTS

President: Prof. K. G. Ploman, Stockholm.
Secretary: Dr. K. O. Granström, Södermalmstorg 4 III tr., Stockholm, Sö.

TEL AVIV OPHTHALMOLOGICAL SOCIETY

President: Dr. D. Arieh-Friedman, 96 Allenby St., Tel Aviv, Palestine.
Secretary: Dr. Sadger Max, 9 Bialik St., Tel Aviv, Palestine.

NATIONAL

AMERICAN MEDICAL ASSOCIATION, SCIENTIFIC ASSEMBLY, SECTION ON OPHTHALMOLOGY

Chairman: Dr. Conrad Berens, 35 E. 70th St., New York City.
Secretary: Dr. R. J. Masters, 23 E. Ohio St., Indianapolis.
Place: Chicago. Time: June 12-16, 1944.

AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY, SECTION ON OPHTHALMOLOGY

President: Dr. James A. Babbitt, 1912 Spruce St., Philadelphia.
President-Elect: Dr. Lawrence T. Post, Metropolitan Bldg., St. Louis.
Executive Secretary-Treasurer: Dr. William L. Benedict, 101–1st Ave. Bldg., Rochester, Minn.

AMERICAN OPHTHALMOLOGICAL SOCIETY

President: Dr. John Green, 3720 Washington Ave., St. Louis.
Secretary-Treasurer: Dr. Walter S. Atkinson, 129 Clinton St., Watertown, N. Y.
Place: Hot Springs, Va. Time: May 29-31, 1944.

ASSOCIATION FOR RESEARCH IN OPHTHALMOLOGY, INC.

Chairman: Dr. Frederick C. Cordes, 384 Post St., San Francisco.
Secretary-Treasurer: Major Brittain F. Payne, School of Aviation Medicine, Randolph Field, Texas.

CANADIAN MEDICAL ASSOCIATION, SECTION ON OPHTHALMOLOGY

President: Dr. Alexander E. MacDonald, 170 St. George St., Toronto.
Secretary-Treasurer: Dr. L. J. Sebert, 170 St. George St., Toronto.

CANADIAN OPHTHALMOLOGICAL SOCIETY

President: Dr. R. Evatt Mathers, 34½ Morris St., Halifax, N. S.
Secretary-Treasurer: Dr. Kenneth B. Johnston, Suite 1, 1509 Sherbrooke St. W., Montreal.
Place: Halifax, N. S. Time: Aug. 4-5, 1944.

NATIONAL SOCIETY FOR THE PREVENTION OF BLINDNESS

President: Mr. Mason H. Bigelow, 1790 Broadway, New York.
Secretary: Miss Regina E. Schneider, 1790 Broadway, New York.
Executive Director: Mrs. Eleanor Brown Merrill, 1790 Broadway, New York.

SECTIONAL

ACADEMY OF MEDICINE OF NORTHERN NEW JERSEY, SECTION ON EYE, EAR, NOSE AND THROAT

President: Dr. N. Zwaifler, 46 Wilbur Ave., Newark.
Secretary: Dr. William F. Keim Jr., 25 Roseville Ave., Newark.
Place: 91 Lincoln Park South, Newark. Time: 8:45 p. m., second Monday of each month, October to May.

CENTRAL WISCONSIN SOCIETY OF OPHTHALMOLOGY AND OTOLARYNGOLOGY

President: Dr. L. J. Friend, 425 E. Grand Ave., Beloit, Wis.
Secretary: Dr. G. L. McCormick, 626 S. Central Ave., Marshfield.

NEW ENGLAND OPHTHALMOLOGICAL SOCIETY

President: Dr. Paul A. Chandler, 5 Bay State Rd., Boston.
Secretary-Treasurer: Dr. Merrill J. King, 264 Beacon St., Boston.
Place: Massachusetts Eye and Ear Infirmary, 243 Charles St., Boston. Time: 8 p. m., third Tuesday of each month from November to April, inclusive.

Pacific Coast Oto-Ophthalmological Society

President: Dr. D. H. O'Rourke, 1612 Tremont Pl., Denver.
Secretary-Treasurer: Dr. C. Allen Dickey, 450 Sutter St., San Francisco.

Puget Sound Academy of Ophthalmology and Oto-Laryngology

President: Dr. L. L. McCoy, 1317 Marion St., Seattle, Wash.
Secretary-Treasurer: Dr. Barton E. Peden, 301 Stimson Bldg., Seattle.
Place: Seattle or Tacoma, Wash. Time: Third Tuesday of each month except June, July and August.

Rock River Valley Eye, Ear, Nose and Throat Society

President: Dr. J. Sheldon Clark, 27 E. Stephenson St., Freeport, Ill.
Secretary-Treasurer: Dr. Harry R. Warner, 321 W. State St., Rockford, Ill.
Place: Rockford, Ill., or Janesville or Beloit, Wis. Time: Third Tuesday of each month from October to April, inclusive.

Saginaw Valley Academy of Ophthalmology and Otolaryngology

President: Dr. M. H. Pike, Midland, Mich.
Secretary-Treasurer: Dr. R. H. Criswell, 407 Phoenix Bldg., Bay City, Mich.
Place: Saginaw or Bay City, Mich. Time: Second Tuesday of each month, except July and August.

Sioux Valley Eye and Ear Academy

President: Dr. J. C. Decker, 515 Francis Bldg., Sioux City, Iowa.
Secretary-Treasurer: Dr. J. E. Dvorak, 408 Davidson Bldg., Sioux City, Iowa.

Southern Medical Association, Section on Eye, Ear, Nose and Throat

Chairman: Dr. John H. Burleson, 414 Navarro St., San Antonio, Texas.
Secretary: Dr. J. W. Jervey Jr., 101 Church St., Greenville, S. C.

Southwestern Academy of Eye, Ear, Nose and Throat

President: Dr. H. L. Brehmer, 221 W. Central Ave., Albuquerque, N. Mex.
Secretary: Dr. A. E. Cruthirds, 1011 Professional Bldg., Phoenix, Ariz.

Southwestern Michigan Triological Society

President: Dr. W. M. Dodge, 716 First National Bank Bldg., Battle Creek.
Secretary-Treasurer: Dr. Kenneth Lowe, 25 W. Michigan Ave., Battle Creek.
Time: Last Thursday of September, October, November, March, April and May.

Western Pennsylvania Eye, Ear, Nose and Throat Society

President: Dr. Ray Parker, 218 Franklin St., Johnston, Pa.
Secretary-Treasurer: Dr. J. McClure Tyson, Deposit Nat'l Bank Bldg., DuBois.

STATE

Arkansas State Medical Society, Eye, Ear, Nose and Throat Section

President: Dr. Raymond C. Cook, 701 Main St., Little Rock.
Secretary: Dr. K. W. Cosgrove, Urquhart Bldg., Little Rock.

Colorado Ophthalmological Society

President: Dr. C. A. Ringle, 912–9th Ave., Greeley.
Secretary: Dr. W. A. Ohmart, 1102 Republic Bldg., Denver.
Place: University Club, Denver. Time: 7:30 p. m., third Saturday of each month, October to May, inclusive.

Connecticut State Medical Society, Section on Eye, Ear, Nose and Throat

President: Dr. F. L. Phillips, 405 Temple St., New Haven.
Secretary-Treasurer: Dr. W. H. Turnley, 1 Atlantic St., Stamford, Conn.

Eye, Ear, Nose and Throat Club of Georgia

President: Dr. E. N. Maner, 247 Bull St., Savannah.
Secretary-Treasurer:: Dr. C. K. McLaughlin, 567 Walnut St., Macon.

Indiana Academy of Ophthalmology and Oto-Laryngology

President: Dr. F. McK. Ruby, Union City.
Secretary: Dr. Edwin W. Dyar Jr., 23 E. Ohio St., Indianapolis.
Place: French Lick. Time: First Wednesday in April.

Iowa Academy of Ophthalmology and Oto-Laryngology

President: Dr. J. K. Von Lackum, 117–3d St. S. E., Cedar Rapids.
Secretary-Treasurer: Dr. B. M. Merkel, 604 Locust St., Des Moines.

Louisiana-Mississippi Ophthalmological and Otolaryngological Society

President: Dr. Val H. Fuchs, 200 Carondelet St., New Orleans.
Secretary-Treasurer: Dr. Edley H. Jones, 1301 Washington St., Vicksburg, Miss.

Michigan State Medical Society, Section of Ophthalmology and Otolaryngology

Chairman: Dr. Robert H. Fraser, 25 W. Michigan Ave., Battle Creek.
Secretary: Dr. R. G. Laird, 114 Fulton St., Grand Rapids.

Minnesota Academy of Ophthalmology and Otolaryngology

President: Dr. George E. McGeary, 920 Medical Arts Bldg., Minneapolis.
Secretary: Dr. William A. Kennedy, 372 St. Peter St., St. Paul.
Time: Second Friday of each month from October to May.

Montana Academy of Oto-Ophthalmology

President: Dr. William Morrison, 208 N. Broadway, Billings, Mont.
Secretary: Dr. Fritz D. Hurd, 309 Medical Arts Bldg., Great Falls.

Nebraska Academy of Ophthalmology and Otolaryngology

President: Dr. W. Howard Morrison, 1500 Medical Arts Bldg., Omaha.
Secretary-Treasurer: Dr. John Peterson, 1307 N St., Lincoln.

New Jersey State Medical Society, Section on Ophthalmology, Otology and Rhinolaryngology

Chairman: Dr B. E. Failing, 31 Lincoln Park, Newark.
Secretary: Dr. George Meyer, 410 Haddon Ave., Camden.

New York State Medical Society, Eye, Ear, Nose and Throat Section

Chairman: Dr. James E. McAskill, 508 Woolworth Bldg., Watertown.
Secretary: Dr. Harold J. Joy, 504 State Tower Bldg., Syracuse 2.

North Carolina Eye, Ear, Nose and Throat Society

President: Dr. Hugh C. Wolfe, 102 N. Elm St., Greensboro.
Secretary: Dr. Vanderbilt F. Couch, 104 W. 4th St., Winston-Salem.

North Dakota Academy of Ophthalmology and Oto-Laryngology

President: Dr. T. W. Buckingham, 405 Broadway, Bismarck.
Secretary-Treasurer: Dr. F. L. Wicks, 516–6th St., Valley City.

Oregon Academy of Ophthalmology and Oto-Laryngology

President: Dr. Paul Neely, 1020 S. W. Taylor St., Portland.
Secretary-Treasurer: Dr. Lewis Jordon, 1020 S. W. Taylor St., Portland.
Place: Good Samaritan Hospital, Portland. Time: Third Tuesday of each month.

Rhode Island Ophthalmological and Otological Society

Acting President: Dr. N. Darrell Harvey, 112 Waterman St., Providence.
Secretary-Treasurer: Dr. Linley C. Happ, 124 Waterman St., Providence.
Place: Rhode Island Medical Society Library, Providence. Time: 8:30 p. m., second Thursday in October, December, February and April.

South Carolina Society of Ophthalmology and Otolaryngology

President: Dr. J. L. Sanders, 222 N. Main St., Greenville.
Secretary: Dr. J. H. Stokes, 125 W. Cheves St., Florence.

Tennessee Academy of Ophthalmology and Otolaryngology

President: Dr. Wesley Wilkerson, 700 Church St., Nashville.
Secretary-Treasurer: Dr. W. D. Stinson, 124 Physicians and Surgeons Bldg., Memphis.

Texas Ophthalmological and Oto-Laryngological Society

President: Dr. F. H. Rosebrough, 603 Navarro St., San Antonio.
Secretary: Dr. M. K. McCullough, 1717 Pacific Ave., Dallas.

Utah Ophthalmological Society

President: Dr. R. B. Maw, 699 E. South Temple, Salt Lake City.
Secretary-Treasurer: Dr. Charles Ruggeri Jr., 1120 Boston Bldg., Salt Lake City.
Place: University Club, Salt Lake City. Time: 7:00 p. m., third Monday of each month.

Virginia Society of Oto-Laryngology and Ophthalmology

President: Dr. Mortimer H. Williams, 30½ Franklin Rd. S. W., Roanoke.
Secretary-Treasurer: Dr. Meade Edmunds, 34 Franklin St., Petersburg.

West Virginia State Medical Association, Eye, Ear, Nose and Throat Section

President: Dr. George Traugh, 309 Cleveland Ave., Fairmont.
Secretary: Dr. Welch England, 621½ Market St., Parkersburg.

LOCAL

Akron Academy of Ophthalmology and Otolaryngology

President: Dr. E. L. Mather, 39 S. Main St., Akron, Ohio.
Secretary-Treasurer: Dr. V. C. Malloy, 2d National Bank Bldg., Akron, Ohio.
Time: First Monday in January, March, May and November.

Atlanta Eye, Ear, Nose and Throat Society

President: Dr. B. M. Cline, 153 Peachtree St. N. E., Atlanta, Ga.
Acting Secretary: Dr. A. V. Hallum, 478 Peachtree St. N. E., Atlanta, Ga.
Place: Grady Hospital. Time: 6:00 p. m., fourth Monday of each month, from October to May.

Baltimore Medical Society, Section on Ophthalmology

Chairman: Dr. Ernst Bodenheimer, 1212 Eutaw Pl., Baltimore.
Secretary: Dr. Thomas R. O'Rourk, 104 W. Madison St., Baltimore.
Place: Medical and Chirurgical Faculty, 1211 Cathedral St. Time: 8:30 p. m., fourth Thursday of each month from October to March.

Birmingham Eye, Ear, Nose and Throat Club

President: Each member, in alphabetical order.
Secretary: Dr. Luther E. Wilson, 919 Woodward Bldg., Birmingham, Ala.
Place: Tutwiler Hotel. Time: 6:30 p. m., second Tuesday of each month, September to May, inclusive.

Brooklyn Ophthalmological Society

President: Dr. William B. Agan, 1 Nevins St., Brooklyn.
Secretary-Treasurer: Dr. Benjamin C. Rosenthal, 140 New York Ave., Brooklyn.
Place: Kings County Medical Society Bldg., 1313 Bedford Ave. Time: Third Thursday in February, April, May, October and December.

Buffalo Ophthalmologic Club

President: Dr. Walter F. King, 519 Delaware Ave., Buffalo.
Secretary-Treasurer: Dr. Sheldon B. Freeman, 196 Linwood Ave., Buffalo.
Time: Second Thursday of each month.

Chattanooga Society of Ophthalmology and Otolaryngology

President: Each member, in alphabetical order.
Secretary: Dr. Douglas Chamberlain, Chattanooga Bank Bldg., Chattanooga, Tenn.
Place: Mountain City Club. Time: Second Thursday of each month from September to May.

Chicago Ophthalmological Society

President: Dr. Vernon M. Leech, 55 E. Washington St., Chicago.
Secretary: Dr. W. A. Mann, 30 N. Michigan Ave., Chicago.
Place: Chicago Towers Club, 505 N. Michigan Ave. Time: Third Monday of each month from October to May.

Cincinnati General Hospital Ophthalmology Staff

Chairman: Dr. D. T. Vail, 441 Vine St., Cincinnati.
Secretary: Dr. A. A. Levin, 441 Vine St., Cincinnati.
Place: Cincinnati General Hospital. Time: 7:45 p. m., third Friday of each month except June, July and August.

Cleveland Ophthalmological Club

Chairman: Dr. Shandor Monson, 1621 Euclid Ave., Cleveland.
Secretary: Dr. Carl Ellenberger, 14805 Detroit Ave., Cleveland.
Time: Second Tuesday in October, December, February and April.

College of Physicians, Philadelphia, Section on Ophthalmology

Chairman: Dr. Alfred Cowan, 1930 Chestnut St., Philadelphia.
Clerk: Dr. W. S. Reese, 1901 Walnut St., Philadelphia.
Time: Third Thursday of every month from October to April, inclusive.

Columbus Ophthalmological and Oto-Laryngological Society

Chairman: Dr. H. D. Emswiler, 370 E. Town St., Columbus, Ohio.
Secretary-Treasurer: Dr. D. G. Sanor, 206 E. State St., Columbus, Ohio.
Place: The Neil House. Time: 6 p. m., first Monday of each month.

Corpus Christi Eye, Ear, Nose and Throat Society

Chairman: Dr. Arthur Padillo, 414 Medical Professional Bldg., Corpus Christi, Texas.
Secretary: Dr. Edgar G. Mathis, 815 Medical Arts Bldg., Corpus Christi, Texas.
Time: Second Friday of each month from October to May.

Dallas Academy of Ophthalmology and Oto-Laryngology

President: Dr. Abell Hardin, Medical Arts Bldg., Dallas, Texas.
Secretary: Dr. Ruby K. Daniel, Medical Arts Bldg., Dallas, Texas.
Place: Dallas Athletic Club. Time: 6:30 p. m., first Tuesday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Des Moines Academy of Ophthalmology and Otolaryngology

President: Dr. H. C. Schmitz, 604 Locust St., Des Moines, Iowa.
Secretary-Treasurer: Dr. Byron M. Merkel, 604 Locust St., Des Moines, Iowa.
Time: 7:45 p. m., third Monday of every month from September to May.

Detroit Ophthalmological Club

Chairman: Dr. Howell L. Begle, 2730 E. Jefferson Ave., Detroit.
Secretary: Dr. C. W. Lepard, 1025 David Whitney Bldg., Detroit.
Time: 6:30 p. m., first Wednesday of each month, November through April.

Detroit Ophthalmological Society

President: Dr. Parker Heath, 1553 Woodward Ave., Detroit.
Secretary: Dr. Leland F. Carter, 1553 Woodward Ave., Detroit.
Place: Club rooms of Wayne County Medical Society. Time: Third Thursday of each month from November to April, inclusive.

Eastern New York Eye, Ear, Nose and Throat Association

President: Appointed at each meeting.
Secretary-Treasurer: Dr. Joseph L. Holohan, 330 State St., Albany.
Time: Third Wednesday in October, November, March, April, May and June.

Eastern Pennsylvania Association of Eye, Ear, Nose and Throat Physicians

President: Dr. James E. Landis, 232 N. 6th St., Reading.
Secretary-Treasurer pro tem: Dr. Paul C. Craig, 232 N. 5th St., Reading.
Time: Last week in April each year.

Fort Worth Eye, Ear, Nose and Throat Society

President: Dr. Rex Howard, 602 W. 10th St., Fort Worth, Texas.
Secretary-Treasurer: Dr. R. H. Gough, Medical Arts Bldg., Fort Worth, Texas.
Place: Medical Hall, Medical Arts Bldg. Time: 7:30 p. m., first Friday of each month except July and August.

Houston Academy of Medicine, Ophthalmological and Oto-Laryngological Section

President: Dr. Felician J. Slataper, 1110-1111 Medical Arts Bldg., Houston, Texas.
Secretary: Dr. Theo. L. Holland, 611 Medical Arts Bldg., Houston, Texas.
Place: Medical Arts Bldg., Harris County Medical Society Rooms. Time: 8 p. m., second Thursday of each month from September to June.

Indianapolis Ophthalmological and Oto-Laryngological Society

President: Dr. Myron Harding, 23 E. Ohio St., Indianapolis.
Secretary: Dr. Kenneth L. Craft, 23 E. Ohio St., Indianapolis.
Place: Indianapolis Athletic Club. Time: 6:30 p. m., second Thursday of each month from November to May.

Kansas City Society of Ophthalmology and Oto-Laryngology

President: Dr. Edgar Johnson, 906 Grand Ave., Kansas City, Mo.
Secretary: Dr. W. E. Keith, 1103 Grand Ave., Kansas City, Mo.
Time: Third Thursday of each month from October to June. The November, January and March meetings are devoted to clinical work.

Long Beach Eye, Ear, Nose and Throat Society

Chairman: Dr. Harold Snow, 614 S. Pacific Ave., San Pedro, Calif.
Secretary-Treasurer: Dr. Oliver R. Nees, 508 Times Bldg., Long Beach, Calif.
Place: Professional Bldg. Time: Last Wednesday of each month from October to May.

Los Angeles Society of Ophthalmology and Otolaryngology

President: Dr. M. E. Trainor, 523 W. 6th St., Los Angeles.
Secretary-Treasurer: Dr. Orrie E. Ghrist, 210 N. Central Ave., Glendale, Calif.
Place: Los Angeles County Medical Association Bldg., 1925 Wilshire Blvd. Time: 6:00 p. m., fourth Monday of each month from September to May, inclusive.

Louisville Eye and Ear Society

President: Dr. Joseph S. Heitger, Heyburn Bldg., Louisville, Ky.
Secretary-Treasurer: Dr. J. W. Fish, 321 W. Broadway, Louisville, Ky.
Place: Brown Hotel. Time. 6:30 p. m., second Thursday of each month from September to May, inclusive.

Lower Anthracite Eye, Ear, Nose and Throat Society

Chairman: Each member in alphabetical order.
Secretary: Dr. James J. Monohan, 31 S. Jardin St., Shenandoah, Pa.

Medical Society of the District of Columbia, Section of Ophthalmology and Otolaryngology

Chairman: Dr. P. S. Constantinople, 1835 I St. N. W., Washington.
Secretary: Dr. Frazier Williams, 1801 I St. N. W., Washington.
Place: 1718 M St. N. W. Time: 8 p. m., third Friday of each month from October to April, inclusive.

Memphis Society of Ophthalmology and Otolaryngology

Chairman: Each member in alphabetical order.
Secretary: Dr. Sam H. Sanders, 1089 Madison Ave., Memphis, Tenn.
Place: Eye Clinic of Memphis Eye, Ear, Nose and Throat Hospital. Time: 8 p. m., second Tuesday of each month from September to May.

Milwaukee Oto-Ophthalmic Society

President: Dr. Edwin C. Bach, 324 E. Wisconsin Ave., Milwaukee.
Secretary-Treasurer: Dr. Ralph T. Rank, 238 W. Wisconsin Ave., Milwaukee.
Place: University Club. Time: 6:30 p. m., second Tuesday of each month.

Montgomery County Medical Society

Chairman: Dr. H. V. Dutrow, 1040 Fidelity Medical Bldg., Dayton, Ohio.
Secretary-Treasurer: Dr. Maitland D. Place, 981 Reibold Bldg., Dayton, Ohio.
Place: Van Cleve Hotel. Time: 6:30 p. m., first Tuesday of each month from October to June, inclusive.

Montreal Ophthalmological Society

President: Dr. J. Rosenbaum, 1396 Ste. Catherine St. W., Montreal, Canada.
Secretary: Dr. L. Tessier, 1230 St. Joseph Blvd. E., Montreal, Canada.
Time: Second Thursday of October, December, February and April.

Nashville Academy of Ophthalmology and Otolaryngology

Chairman: Dr. M. M. Cullom, 700 Church St., Nashville, Tenn.
Secretary: Dr. R. E. Sullivan, 432 Doctors Bldg., Nashvile, Tenn.
Place: St. Thomas Hospital. Time: 8 p. m., third Monday of each month from October to May.

New Haven Ophthalmological Society

President: Dr. William H. Ryder, 185 Church St., New Haven, Conn.
Secretary: Dr. Frederick A. Wiess, 255 Bradley St., New Haven, Conn.

New Orleans Ophthalmological and Oto-Laryngological Society

President: Dr. W. B. Clark, 1012 American Bank Bldg., New Orleans.
Secretary: Dr. Mercer G. Lynch, 1018 Maison Blanche Bldg., New Orleans.
Place: Louisiana State University Medical Bldg. Time: 8 p. m., second Tuesday of each month from October to May.

New York Academy of Medicine, Section of Ophthalmology

Chairman: Dr. Frank C. Keil, 660 Madison Ave., New York.
Secretary: Dr. Willis S. Knighton, 121 E. 61st St., New York.
Time: 8:30 p. m., third Monday of every month from October to May, inclusive.

New York Society for Clinical Ophthalmology

President: Dr. Sigmund Agatston, 875–5th Ave., New York.
Secretary: Dr. Benjamin Esterman, 983 Park Ave., New York.
Place: Squibb Hall, 745–5th Ave. Time: 8 p. m., first Monday of each month from October to May, inclusive.

Oklahoma City Academy of Ophthalmology and Otolaryngology

President: Dr. James P. Luton, 117 N. Broadway, Oklahoma City.
Secretary: Dr. Harvey O. Randel, 117 N. Broadway, Oklahoma City.
Place: University Hospital. Time: Second Tuesday of each month from September to May.

Omaha and Council Bluffs Ophthalmological and Oto-Laryngological Society

President: Dr. D. D. Stonecypher, Nebraska City, Neb.
Secretary-Treasurer: Dr. W. Howard Morrison, 1500 Medical Arts Bldg., Omaha.
Place: Omaha Club, 20th and Douglas Sts., Omaha. Time: 6 p. m. dinner; 7 p. m. program; third Wednesday of each month from October to May.

Passaic-Bergen Ophthalmological Club

President: Dr. Thomas Sanfacon, 340 Park Ave., Paterson, N. J.
Secretary-Treasurer: Dr. J. Averbach, 435 Clinton Ave., Clinton, N. J.
Place: Paterson Eye and Ear Infirmary. Time: 9 p. m., last Friday of every month, except June, July and August.

Philadelphia County Medical Society, Eye Section

President: Dr. Wilfred E. Fry, 1819 Chestnut St., Philadelphia.
Secretary: Dr. Glen Gregory Gibson, 255 S. 17th St., Philadelphia.
Time: First Thursday of each month from October to May.

Pittsburgh Ophthalmological Society

President: Dr. John B. McMurray, 6 S. Main St., Washington, Pa.
Secretary: Dr. George H. Shuman, 351–5th Ave., Pittsburgh.
Place: Pittsburgh Academy of Medicine Bldg. Time: Fourth Monday of each month, except June, July, August and September.

Reading Eye, Ear, Nose and Throat Society

President: Dr. R. M. Brickbauer, Shillington, Pa.
Secretary: Dr. Paul C. Craig, 232 N. 5th St., Reading, Pa.
Place: Wyomissing Club. Time: 6:30 p. m., third Wednesday of each month from October to July.

Richmond Ophthalmological and Oto-Laryngological Society

President: Dr. Peter N. Pastore, Medical College of Virginia, Richmond, Va.
Secretary: Dr. Clifford A. Folkes, Professional Bldg., Richmond, Va.
Place: Westmoreland Club. Time: 6 p. m., second Monday of each month from October to May.

Rochester Eye, Ear, Nose and Throat Society

President: Dr. Frank Barber, 75 S. Fitzhugh St., Rochester, N. Y.
Secretary-Treasurer: Dr. Charles T. Sullivan, 277 Alexander St., Rochester, N. Y.

St. Louis Ophthalmic Society

President: Dr. C. C. Beisbarth, 3720 Washington Blvd., St. Louis.
Secretary: Dr. H. R. Hildreth, 508 N. Grand Blvd., St. Louis.
Place: Oscar Johnson Institute. Time: Clinical meeting, 5:30 p. m., dinner and scientific meeting 6:30 p. m., fourth Friday of each month from October to April, inclusive, except December.

San Antonio Ophthalmo-Oto-Laryngological Society

President: Dr. Belvin Pritchett, 705 E. Houston St., San Antonio 5, Texas.
Secretary-Treasurer: Lt. Col. John L. Matthews, AAF School of Aviation Medicine, Randolph Field, Texas.
Place: San Antonio, Brooke General Hospital, Randolph Field or San Antonio Aviation Cadet Center. Time: 7 p. m., second Tuesday of each month from October to May.

San Francisco County Medical Society, Section on Eye, Ear, Nose and Throat

Chairman: Dr. Roy H. Parkinson, 870 Market St., San Francisco.
Secretary: Dr. A. G. Rawlins, 384 Post St., San Francisco.
Place: Society's Bldg., 2180 Washington St., San Francisco. Time: Fourth Tuesday of every month except June, July and December.

Shreveport Eye, Ear, Nose and Throat Society

President: Dr. David C. Swearingen, Slattery Bldg., Shreveport, La.
Secretary-Treasurer: Dr. Kenneth Jones, Medical Arts Bldg., Shreveport, La.
Place: Shreveport Charity Hospital. Time: 7:30 p. m., first Monday of every month except July, August and September.

Spokane Academy of Ophthalmology and Oto-Laryngology

President: Dr. Clarence A. Veasey Sr., 421 W. Riverside Ave., Spokane, Wash.
Secretary: Dr. Clarence A. Veasey Jr., 421 W. Riverside Ave., Spokane, Wash.
Place: Spokane Medical Library. Time: 8 p. m., fourth Tuesday of each month except June, July and August.

Syracuse Eye, Ear, Nose and Throat Society

President: Dr. A. H. Rubenstein, 713 E. Genesee St., Syracuse, N. Y.
Secretary-Treasurer: Dr. I. H. Blaisdell, 713 E. Genesee St., Syracuse, N. Y.
Place: University Club. Time: First Tuesday of each month except June, July and August.

Toledo Eye, Ear, Nose and Throat Society

Chairman: Dr. E. A. Orwig, 420 Madison Ave., Toledo, Ohio.
Secretary: Dr. E. W. Campbell, 316 Michigan St., Toledo, Ohio.
Place: Toledo Club. Time: Each month except June, July and August.

Toronto Academy of Medicine, Section of Ophthalmology

Chairman: Dr. W. R. F. Luke, 316 Medical Arts Bldg., Toronto, Canada.
Secretary: Dr. W. T. Gratton, 216 Medical Arts Bldg., Toronto, Canada.
Place: Academy of Medicine, 13 Queens Park. Time: First Monday of each month, November to April.

Washington, D. C., Ophthalmological Society

President: Dr. S. Bockoven, 1752 Massachusetts Ave., Washington, D. C.
Secretary-Treasurer: Dr. John Lloyd, 1218–16th St. N. W., Washington, D. C.
Place: Medical Society of District of Columbia Bldg., 1718 M St. N. W., Washington, D. C. Time: 7:30 p. m., first Monday in November, January, March and May.

Wilkes-Barre Ophthalmological Society

Chairman: Each member in turn.
Secretary: Dr. Samuel T. Buckman, 70 S. Franklin St., Wilkes-Barre, Pa.
Place: Office of chairman. Time: Last Tuesday of each month from October to May.